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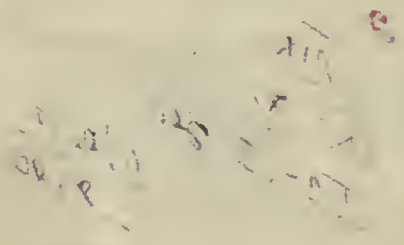

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THE

CHEMICAL NEWS

AND

Journal of Physical Science.

Edited by] [*Wm. Crookes, F.R.S.*

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THE CHEMICAL NEWS

VOLUME XIV.

No. 344.—July 6, 1866.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Note on By-products in the Preparation of Propylene, by HENRY BASSETT.

THE reaction between iodide of allyl, mercury, and hydrochloric acid is generally considered to yield nothing but pure propylene, Gerhardt, however, stating that the gas thus obtained contains traces of a compound containing chlorine or iodine, which may be condensed by a freezing mixture.

Having occasion to prepare a quantity of propylene by the process in question, the gas was passed through a bottle containing cold water, when a considerable quantity of liquid was condensed. This was separated, and again treated with mercury and hydrochloric acid till no further action took place, and then washed, dried, and submitted to fractional distillation. It was thus separated into two portions, the larger being heavier than water, almost incombustible, and boiling very constantly at 90°. Determinations of carbon, hydrogen, and iodine were made, the results agreeing closely with the formula C_3H_7I, and the substance is obviously identical with the iodide of propyl obtained by Simpson by the action of hydriodic acid on iodide of allyl.

The other portion was lighter than water, and burned with a very smoky flame tinged with green at the edges. It had a strong ethereal smell, and boiled between 40° and 45°. It contained a large quantity of chlorine, and only a mere trace of iodine, but I was unable to fix its composition by analysis, owing to the accidental loss of my whole product; there can, however, be very little doubt that it is the chloride corresponding to the iodide described above, formed by the direct combination of propylene and hydrochloric acid—chloride of propyl boiling at 40°.

By the action of sodium-amalgam on the iodide, in presence of acetic ether, a small but appreciable quantity of oily mercury compound was formed, whereas Wanklyn's β iodide of hexyl, to which this iodide is probably analogous, was found by Frankland not to produce a trace.

The compound thus formed seems, however, to differ somewhat in properties from the compounds of mercury with the normal alcohol-radicals, as it has a decided tendency to crystallise, and the fine crystalline precipitate formed by addition of iodine to its alcoholic solution is rapidly altered by evaporation, or by the addition of water, a red substance being precipitated, and the liquid acquiring an intolerably pungent smell. The small quantity obtained prevented anything like an examination of its nature, &c., which, however, would possess some interest.

On Peroxide of Hydrogen and Ozone (Second Part), by M. C. WELTZIEN.*

M. WELTZIEN first notices the commonly-received opinion that peroxide of hydrogen is water containing an atom of oxygen in loose combination, which is easily separated and transferred to oxidisable bodies. According to this view oxygenated water is a powerful oxidiser. The author adds, however, that pure peroxide of hydrogen in aqueous solution does not decompose spontaneously, and is not an oxidising substance in the ordinary sense of the word. Schönbein has proved that phosphorous acid and phosphorus may exist for some time in contact with peroxide of hydrogen. He has also shown that water in contact with phosphorus and air, and therefore containing phosphorous acid, may be boiled for some hours without losing the power of rendering starch blue in the presence of ferrous sulphate. A dilute solution of peroxide of hydrogen may be concentrated by heat, and, according to Schönbein, the peroxide may be distilled with ether. Meissner, however, denies that the peroxide can exist in a state of vapour.

But Weltzien states that the peroxide may be distilled without ether. If, he says, a dilute solution of oxygenated water be placed in a retort with the neck turned up, so as to prevent the projection of any of the liquid into the receiver, and then one half be distilled, the distillate will give the reaction of peroxide of hydrogen with ether and chromic acid.

Schönbein considers oxygenated water as water united with *positive active* oxygen (antozone); Meissner regards it as water *positively* polarised by antozone. M. Lenssen goes further, and asserts that acid solutions of peroxide of hydrogen contain *positive active* oxygen, while alkaline solutions contain *negative active* oxygen. Schönbein and Meissner, too, both often speak of the oxidation of water by antozone.

Water is only decomposed by chlorine at a boiling temperature, or under the influence of light, and then but slowly; its decomposition by ozone has never been observed, and such a decomposition would seem to be paradoxical. Peroxide of hydrogen, however, is easily decomposed by chlorine, bromine, and iodine, as well as by ozone, oxygen being set at liberty.

From a comparison of the action of chlorine and that of ozone on the peroxide of hydrogen, M. Weltzien is convinced—1. That all the oxygen disengaged in these reactions comes from the peroxide of hydrogen—

$$Cl_2 + H_2O_2 = 2HCl + O_2$$
$$O + H_2O_2 = H_2O + O_2.$$

2. That the hydrogen is held with much less force in

* Abstract from *Bulletin de la Société Chimique, &c.*, May, 1866, p. 122.

the peroxide than in water, and hence the peroxide is an energetic reducing agent.

Starting from this point of view, that in all the reactions the two atoms of oxygen in the peroxide leave the compound together either as a molecule of free oxygen, or to enter into a new combination, we have, in the first instance, a reduction in the strict sense of the word, and in the second also a reduction, notwithstanding that there is found at the same time a combination richer in oxygen.

As illustrations of the first we have—

$$Ag_2[O + H_2]O_2 = Ag_2 + H_2O + O_2$$
$$Ag_2[O_2 + H_2]O_2 = Ag_2O + 2H_2O + 2O_2$$
$$CaCl_2[O_2 + 2H_2]O_2 = CaCl_2 + 2H_2O + 2O_2.$$
$$H_2crO_3[O + H_2]O_2 + H_2O_2 = H_6CrO_6 + 2H_2O + 3O_2$$
$$H_2c_1O_3[O + H_2]O_2$$

$$\left.\begin{matrix} KmnO_2[O_2 + 2H_2]O_2 \\ KmnO_2[O_2 + 2H_2]O_2 \end{matrix}\right\} = 2HKO + H_6MnO_6 + 4O_2.$$

Thus there are as many molecules of oxygen set free as there are molecules of peroxide of hydrogen required to produce the reaction.

As examples of the second class we have, among others, the following:—

$$H_3AsO_2[O + H_2]O_2 = H_3AsO_4 + H_2O$$
$$H_3PO_2[O + H_2]O_2 = H_3PO_4 + H_2O.$$

In other cases we have the molecule of peroxide of hydrogen added to the molecule of the body presented to it, whether this is an elementary molecule or a compound molecule formed of atoms of various elements. From this fixation of the peroxide results a hydrate of a metal, of an acid, or a peroxide, according to the nature of the body acted on by the peroxide of hydrogen.

The following are examples:—

Metallic hydrates—$Mg + H_2O_2 = H_2MgO_2$
$Fe + 3H_2O_2 = H_6FeO_6.$
$Al + 3H_2O_2 = H_6AlO_6.$
$2Tl_2 + 4H_2O_2 = 2HTlO + H_6TlO_6.$*

Hydrates of acids—$As_2 + 3H_2O_2 = 2H_3AsO_3.$
$SO_2 + 2H_2O_2 = H_2SO_4.$†

(To be continued.)

TECHNICAL CHEMISTRY.

New Method for Extracting Bromine and Iodine from Seaweeds, and of Estimating Iodine by Means of Alkaline Hyposulphites,‡ by M. ED. MORIDE.

SODA has long been obtained by burning dried seaweeds in open trenches. But great loss is sustained in this primitive operation; part of the alkaline salts are transformed into sulphuretted products or insoluble silicates. Chlorides of magnesium and iodides of sodium are decomposed, and then hydrochloric acid, iodine, bromides, and chlorides of sodium volatilise.

Many attempts have been made to directly obtain the soluble salts contained in the weeds by means of maceration, both cold and hot; but the transportation of them to the factory was often impracticable, the product of the maceration decolourised with difficulty, and the evaporation of the liquids was expensive.

In England Mr. Edward Stanford has lately submitted the weeds to dry distillation. The results of the operation were empyreumatic oils and carbonaceous residues, from which latter he extracted the salts, and then the bromine and iodine; this method is also a failure,* necessitating, as it does, considerable manual labour, large quantity of material, and difficult transport.

My method avoids all these inconveniences. In fact, I merely carbonise the previously dried weeds in the open air during all weathers, and on the spot where they are collected, using a portable apparatus—a kind of small furnace, which produces a charcoal which I then easily and quickly wash in a displacement apparatus. 100 parts of fresh weed generally represent 20 parts of dry, 7.5 of carbonaceous residue, and 3 of ashes.

As to the quantities of iodine and bromine, they vary according to the kind of plant employed; thus, as proved by M. Gaultier de Claubry, it is the large laminaria which contain most iodine.

The product of the lixiviation is concentrated in vats heated by steam; I then extract the sulphates of potash and the chlorides of sodium and potassium; then, after having added a hypochlorite or some hyponitric acid treat them by benzol in a special apparatus so arranged that the carbide of hydrogen removes the iodine from the liquids to give it to the soda or potash, and then thus regenerated proceed indefinitely.

The mixture of alkaline iodide and iodate is next precipitated by hydrochloric acid, or better still, by chlorinated liquids, residues of the manufacture of bromine, and the iodide obtained is then dried. Finally, the bromine is extracted from the liquids freed from benzol, either by treating by sulphuric acid and peroxide of manganese and distilling, or by directly eliminating it in a liquid state in the liquids concentrated and strongly acidulated.

Estimation of Iodine.—The method by which I propose to estimate iodine is based on two well-known principles: one, the solubility of iodine in benzol or petroleum; the other, the decolouration of iodised solutions by hyposulphite of soda, which, on account of its stability, is preferable to the sulphite, or sulphurous acid recommended by Dupasquier and M. Bunsen.

The operation is as follows:—

First prepare a normal liquid containing, for each litre of water, about forty grammes of hyposulphite of soda, so that fifty cubic centimetres of this solution will completely decolourise one gramme of iodine.

Then take ten cubic centimetres of the iodised liquid to be tested, diluted with water, if it be very concentrated or rich in iodine; then add carefully, after it has been acidulated with hydrochloric acid, some drops of hyponitric acid. When it becomes yellow, shake it with benzol or petroleum, which will immediately turn rose or violet. Separate the iodised benzol from the acid liquid, and repeat the operation until the solvent liquid ceases to become coloured.

Collect the iodised benzol resulting from these treatments, and wash it with distilled water, which will remove all traces of chlorated or bromated compounds without removing any appreciable quantity of iodine. Then, while stirring incessantly, add, by means of a burette, graduated to tenths of cubic centimetres, the normal hyposulphite liquid until all colour is destroyed; each cubic demi-centimetre of the normal liquid will correspond to one centigramme of iodine contained in the liquids assayed.

* As this oxide does not appear to exist, there is formed—
H_2TlO_4 and $2H_2O$.

† Schönbein regards this action as a case of the reduction of oxygenated water: $HO_2 + SO_2 = HO + SO_3$.

‡ *Comptes Rendus*, vol. lxii., p. 1002.

* M. Moride is mistaken: Mr. Stanford's works, we believe, are in active and profitable operation.

It is always necessary to desulphurise solutions containing sulphides, sulphites, or hyposulphites, by boiling them with nitric, sulphuric, or hydrochloric acid.

To ascertain the purity of commercial iodines, dissolve fifty centigrammes or one gramme, in diluted alcohol, and operate as above.

To ascertain the quantity of iodine in dry or wet sea plants, cut them into small pieces; place them in a porcelain capsule and cover them with alcohol; set fire to the alcohol, carefully stir the mass with a glass rod, and the carbon will be obtained, without loss of iodine; then well wash the latter, and act on the solution as above described.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, June 21.

Prof. A. W. Williamson, *Ph.D., F.R.S., Vice-President, in the Chair.*

The minutes of the previous meeting were confirmed. Mr. Charles Phillips and Mr. W. F. Flowers were formally admitted Fellows of the Society, and the following gentlemen were duly elected, viz.:—Dr. Arthur Gamgee, University of Edinburgh; Mr. J. H. Lightbown, Corporation Street, Manchester; Mr. Frederick Keating Stock, Darlington; and Mr. Edward Isaacs Sparks, Corpus Christi College, Oxford. For the first time were read the names of Mr. Robert Biggs, Deputy-Coroner, 17, Charles Street, Bath, and Mr. David Page, Galebeck Powder Mills, near Kendal. For the second time were read the names of the following candidates, viz.:—Mr. W. Chandler Roberts, Royal School of Mines; and Mr. Edward P. H. Vaughan, Patent Agent, of Chancery Lane and Primrose Hill.

Dr. F. Crace Calvert offered some interesting observations embodied in a paper by Mr. Johnson and himself, entitled "*On the Action of Acids upon Metals and Alloys.*" The authors have examined the actions of the common mineral acids, especially nitric, sulphuric, and hydrochloric acids, upon the metals zinc, tin, and copper, and upon the most important of their alloys, particularly brass and bronze. The results obtained are of great scientific interest, besides having a practical value in connexion with the applications of these metals in the arts. The most important conclusions established by the authors may be thus stated:—1st. The extent of action of any acid upon an alloy cannot always be predicted from the known effects of the same acid upon the individual metals. 2nd. A variation in the proportion of the constituent metals, no greater even than 10 per cent., will sometimes entirely change the character of an alloy so far as regards its corrosion by or solubility in acids. 3rd. The influence of water in modifying the action of acids upon metals and alloys is in nearly all cases very considerable. Amongst other interesting facts, Dr. Calvert mentioned the following:—Cubes of pure zinc were prepared and submitted to the action of sulphuric acid of various degrees of concentration, *i. e.*, from the monohydrate to a dilute acid containing in all ten atoms of water, for a uniform period of time—two hours—and at various degrees of temperature. With the concentrated acid there was no action in the cold, but when heated to 150° C. the metal slowly dissolved with evolution of sulphurous acid. If the zinc be acted upon with the tetra- or penta-hydrated sulphuric acid, much sulphuretted hydrogen was set free, accompanied by traces of sulphurous acid; and with acids containing seven atoms and upwards of water only hydrogen was evolved. Unless water were present in sufficient amount to dissolve the sulphate of zinc formed, there was, of course, a retardation of the action. The condition of the metallic surface had a marked influence upon the rate of solution. A newly-filed cube of pure zinc, washed with alcohol and dried, was scarcely acted upon by SO_3, 9HO in the cold, whilst a similar cube (centimetre), left exposed to the air for a week and thereby slightly oxidised, dissolved to the extent of 3 grammes in the same acid in two hours. Copper placed in contact with oil of vitriol at 150° C. gave off sulphurous acid only, but in the flask were found, besides sulphate of copper, the sulphide of that metal and free sulphur. The same acid acting upon tin also gave sulphurous acid and free sulphur; and the acids, SO_3, 4HO, and SO_3, 5HO, dissolved tin with evolution of mixtures of HS and SO_2, without formation of a metallic sulphide. With respect to the action of monohydrated sulphuric acid upon the alloys of copper and zinc the authors found that a brass composed of these metals in the proportion of their atomic weights, or CuZn, dissolved uniformly, giving off sulphurous acid; that when the amount of copper was increased the metal dissolved *faster* than did other alloys containing an excess of zinc. With the terhydrated sulphuric acid the contrary result was observed, although sulphurous acid was in this case also the gaseous product of the reaction. The alloy, CuZn, containing nearly equal parts by weight of copper and zinc, was uniformly dissolved by nitric acid of specific gravity 1·14; but when a more dilute acid was employed, viz., that having specific gravity 1·08, the zinc and copper were dissolved in the proportion of 5:1, by 24 hours' immersion. The action of concentrated hydrochloric acid was somewhat remarkable; the alloy CuZn lost only the zinc, a cube of spongy copper remaining undissolved. With dilute acid, specific gravity 1·05, none of the zinc was dissolved out in the space of an hour, but with the alloys containing four or five atoms of zinc to one of copper nearly all of the zinc entered into solution. Alloys containing more than two atoms of zinc to one of copper were rapidly attacked by dilute nitric acid of specific gravity 1·10, whilst the alloy CuZn was scarcely affected; more copper conferred even a greater degree of protection. With respect to the bronzes, the alloys CuSn and Cu_2Sn were but very slightly attacked by nitric acid, specific gravity 1·25, whilst alloys containing a larger proportion of either constituent were much more rapidly dissolved. The alloys containing copper in excess were protected from the action of concentrated hydrochloric acid, whilst those containing tin in excess dissolved much more rapidly than the individual metals. All alloys of copper and tin were to some extent protected against the action of concentrated sulphuric acid; the behaviour of those containing 10, 15, and 35 per cent. of copper was nearly identical.

Dr. Stevenson made inquiries respecting the anomaly observed in the simultaneous liberation of sulphurous acid and sulphuretted hydrogen from zinc and sulphuric acid; and

Dr. Letheby inquired whether at the point of transition from sulphurous acid to sulphuretted hydrogen any free hydrogen was liberated.

Dr. Calvert said the facts stood thus:—Bihydrated sulphuric acid did not act in the cold upon pure zinc, but that at 130°C. sulphurous acid was freely evolved, accompanied by a little sulphuretted hydrogen. At the temperature of 150°C. a mixture of the gases appeared—lead paper was blackened, whilst the odour indicated sulphurous acid—and when more diluted acids were employed, such as the hydrates containing from 3 to 6 atoms of water, the gas evolved was chiefly sulphuretted hydrogen. He had not ascertained whether any free hydrogen was contained in the evolved gases.

Mr. Warington, jun., said this reaction reminded him of the occasional production of orange sulphide of antimony in the flasks used for the preparation of antimonietted hydrogen, which he had ascertained was due to the too free use of the oil of vitriol bottle.

Dr. Debus then delivered a discourse "*On the Constitu-*

tion of some Carbon Compounds." The lecturer resumed the subject of a communication to the Society which was read in January last. Starting from the ethylic and propylic hydrides, the author proceeded to examine their respective oxygen derivatives, and suggested that the hydrocarbons C_2H_6 and C_3H_8 were made up of certain residues (CH_2 and CH_3) of the marsh gas molecules employed in their preparation, thus—

Methylic hydride (marsh gas) H, CH_3
Ethylic hydride (methyl) . CH_3, CH_3
Propylic hydride . . . CH_3, CH_2, CH_3.

Oxygen may be present in organic compounds, either in the form of the water-residue hydroxyl, HO=Ḧ, or as a substitute for hydrogen; we have, therefore, amongst others—

Alcohol . . . . . CH_3, $CH_2Ḣ$
Acetic acid . . . . . CH_3, $COḢ$

The whole series of bodies derivable from ethylic hydride and from propylic hydride respectively were shown in two diagrams.

Table 1.

CH_3,	CH_3	= Ethylic-hydride
CH_3,	$CH_2Ḣ$	= Ethylic alcohol
CH_3,	COH	= Aldehyde
CH_3,	$COḢ$	= Acetic acid
$CH_2Ḣ$,	$COḢ$	= Glycollic acid
COH,	$COḢ$	= Glyoxylic acid
$COḢ$,	$COḢ$	= Oxalic acid
$CH_2Ḣ$,	$CH_2Ḣ$	= Glycol
COH,	COH	= Glyoxal

Table 2.

CH_3,	CH_2,	CH_3	= Propylic hydride
CH_3,	CH_2,	$CH_2Ḣ$	= Propylic alcohol
CH_3,	CHḦ,	CH_3	= Pseudo-propylic alcohol
CH_3,	CH_2,	COH	= Propionic aldehyde
CH_3,	CO,	CH_3	= Acetone
CH_3,	CH_2,	$COḢ$	= Propionic acid
CH_2H,	CH_2,	$COḢ$	= Lactic acid (α)
CH_3,	CHḦ,	$COḢ$	= Lactic acid (β)
CH_3,	CO,	$COḢ$	= Pyruvic acid
COH,	CH_2,	$COḢ$	= Malonic acid
$COḢ$,	CHḦ,	$COḢ$	= Tartronic acid
$COḢ$,	CO,	$COḢ$	= Mesoxalic acid
CH_3,	CHḦ,	$CH_2Ḣ$	= Propyl-glycol
$CH_2Ḣ$,	CHḦ,	$CH_2Ḣ$	= Glycerin
$CH_2Ḣ$,	CHḦ,	$COḢ$	= Glyceric acid

The author proceeded in the next place to quote a number of examples in order to show that the modes of formation, decompositions, and other chemical properties of the members of both groups were fully accounted for in the integral formulæ proposed; thus from sodium-methyl and carbonic acid we obtain sodic acetate, and from cyanide of methyl, CH_3, CN, in a similar manner, alkaline acetates and ammonia; and, conversely, the acetates furnish marsh gas and, by electro-decomposition, methyl itself. Then, the different groups, CH_3, CH_2, CH, $COḢ$, &c, impart to the bodies in which they are contained certain specific properties; thus, an organic substance comports itself like acetic aldehyde when it contains the group COH; acid properties may be inferred from the presence of $COḢ$; and the ketones owe their peculiar properties to the group CO contained in them. The author stated in conclusion that, according to present experience, the water residue Ḧ cannot occur more than once in combination with the same atom of carbon; thus we have ethylic alcohol, CH_3, $CH_2Ḣ$, and ethylic glycol, $CH_2Ḣ$, $CH_2Ḣ$, but neither methyl-glycol nor ethyl-glycerin, $CH_2Ḣ$, CHḦḦ, is known to chemists, although their preparation has been frequently attempted. It would therefore be possible to draw up a complete list of all the possible oxygen-derivatives of a hydrocarbon of known constitution, and to determine *à priori* the properties of the several compounds. This has been done for propylic hydride, and Dr. Debus finds that *thirty-seven* oxygen-derivatives are theoretically possible, of which 17 only are yet known.

The CHAIRMAN moved a vote of thanks to the respective authors, and announced that it had been decided by the Council to hold one more meeting before adjourning for the vacation. There were still a few papers in hand, and he was himself prepared to lay before the Society a proposal relating to *Chemical Notation*. An extraordinary meeting would therefore be held on Thursday, July 5.

Dr. ODLING read the titles of the papers in question; they were as follows:—"*On the Reduction of the Oxides of Nitrogen by Metallic Copper*," by Mr. Thorpe. "*Note on Ethyl-hexyl Ether*," by Mr. Schorlemmer; and, by the same author, "*On the Hydrocarbons in Crude Benzol.*" Dr. Williamson's subject was "*On the Constitution and Representation of Organic Compounds.*" The meeting was then adjourned.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, May 4, 1866.

Sir HENRY HOLLAND, *Bart., M.D., D.C.L., F.R.S., President, in the Chair.*

On Recent Progress in the History of proposed Substitutes for Gunpowder, by Professor F. A. ABEL, *F.R.S., V.P.C.S., Chemist to the War Department.*

THE changes which have been effected in the composition of gunpowder since its first application as a propelling agent, have been limited to small variations in the proportions of its constituents. But the modifications which have from time to time been introduced into the details of its manufacture, *e.g.*, the preparation of the ingredients, their incorporation, and the conversion of the mixture into compact masses (grains, &c.) of different size and density, have been sufficiently important and successful to secure the fulfilment by gunpowder, in a more or less efficient manner, of the very various requirements of military science and of different branches of industry.

The characteristics of gunpowder, as an explosive material of permanent character, the action of which is susceptible of great modification, are mainly ascribable to the peculiar properties of the oxidising agent, saltpetre. Frequent attempts have been made to replace this constituent of gunpowder by other nitrates (such as those of sodium, lead, and barium); but, although materials suitable for blasting operations have been thus prepared (such as soda-gunpowder, and barytic powder, or *poudre saxifragine*), all mixtures of this class, hitherto produced, have exhibited important defects, when compared with gunpowder manufactured for propelling purposes.

The well-known oxidising agent, chlorate of potash, which differs from saltpetre only in containing chlorine in the place of nitrogen, is far more energetic in its action upon oxidisable bodies than any of the nitrates. Thus, a mixture of chlorate of potash with charcoal alone deflagrates as violently as gunpowder, and is far more readily inflamed by percussion than the latter; while a mixture analogous to gunpowder, containing chlorate of potash in place of saltpetre, detonates violently when struck with moderate force, and acts far too destructively, on account of the rapidity of its explosion, to admit of its safe employment in fire-arms.

Many years ago, a mixture known as German or whiet gunpowder, and consisting of chlorate of potash, ferrocyanide of potassium, and sugar, was proposed and tried without success as a substitute for gunpowder; and since then many preparations of similar character have been suggested for employment either as blasting and mining agents, or for use in shells, or even for all the puposes to which gunpowder is applied. The most promising of these, claimed as discoveries by Mr. Horsley and Dr. Ehrhardt, are mixtures of chlorate of potash with substances of permanent character and readily obtained, containing both carbon and hydrogen; such as tannic and gallic acids, and some kinds of resins. These mixtures are much less violently detonating than most of the explosive mixtures containing chlorate of potash, while, if well prepared, they are decidedly more powerful, as explosives, than gunpowder. For blasting purposes, some of these mixtures probably possess decided advantages over ordinary blasting powder, and possibly they may also be susceptible of employment for sporting purposes; but they are not applicable to fire-arms used for war-purposes, because, in order to ensure the requisite uniformity of action, the ingredients must be submitted to proper processes of incorporation, &c., such as are applied to the manufacture of gunpowder; and this treatment would render the mixtures far more violent, and consequently destructive in their action upon fire-arms, than if used in the form of crude mixtures.

A comparatively very safe application of chlorate of potash to the production of a substitute for gunpowder was made about six years ago by a German chemical manufacturer, M. Hochstädter. Unsized (blotting) paper was thoroughly soaked in, and coated with, a thin paste consisting of chlorate of potash, finely-divided charcoal, a small quantity of sulphide of antimony, and a little starch, gum, or some similar binding material, water being used as the solvent and mixing agent. The paper was rolled up very compactly and dried in that form. In this manner, very firm rolls of an explosive material are obtained, which burns with considerable violence in open air, and the propelling effect of which, in small arms, has occasionally been found greater than that of a corresponding charge of rifle powder. Moreover, the material, if submitted in small portions to violent percussion, exhibits but little tendency to detonation. But as no reliance can be placed on a sufficient uniformity of action, in a fire-arm, of these explosive rolls, this alone sufficed to prevent their competing with powder. The same description of explosive preparation, differing only from that of M. Hochstädter in a trifling modification of its composition, which is certainly not likely to lead to its greater success, has recently been brought forward in this country by M. Reichen and Mr. Melland.

One or two other much cruder explosive preparations, containing chlorate of potash, alone or in conjunction with saltpetre, have met with some application to blasting purposes. One of these consisted of spent tan, in small fragments, which was saturated with the oxidising agent, and afterwards dusted over with sulphur. When flame or a red-hot iron is applied to this preparation, it deflagrates very slowly and imperfectly; but when employed in blast-holes, where it is confined within a small space, it developes sufficient explosive force to do good work. In addition to comparative cheapness, the great advantage of safety was claimed for this material by its inventor, a claim which was substantiated by the partial destruction by fire, on two occasions, of a manufactory of the substance near Plymouth, without the occurrence of an explosion.

The accidental explosions of gunpowder which are occasionally heard of, occur, in most instances, at the manufactories, and in the course of some operation (especially that of incorporation) to which the explosive mixture is submitted. The only means of guarding against, or reducing as much as possible, the liability to the occurrence of these accidents, consist in the strictest attention to the precautionary measures and regulations, which experience has proved to be essential to safety, and which, in spite of the strictest supervision, are unquestionably sometimes overlooked or imperfectly carried out by workmen. Explosions of gunpowder, generally of a serious character, do occur, however, though very rarely, during the transport of the material, or in the magazines where it is stored. The great explosion of a gunpowder magazine at Erith in September, 1864, specially directed the attention of Government and the public generally to the necessity of adopting measures for reducing, as much as possible, the risk of occurrence of such disastrous accidents. Hence, much interest has recently been excited by a well-known method of rendering gunpowder less dangerous in its character, which has been brought prominently before the public by Mr. Gale, and which consists of diluting powder, or separating its grains from each other, by means of a finely powdered non-explosive substance. Attempts have several times been made in past years to apply to practical purposes the obvious fact, of which nobody acquainted with the nature of gunpowder could be ignorant, that, by interposing between the grains of powder a sufficient quantity of a finely divided material, which offers great resistance to the transmission of heat, the ignition of separate grains of the entire mass may be accomplished without risk of inflaming contiguous grains. In 1835, Piobert made a series of experiments with the view to apply this fact practically to reduce the explosiveness of gunpowder, and similar experiments of an extensive character were carried on by a Russian chemist, Fadéiff, between 1841 and 1844. These experimenters found that the object in view might be attained by diluting gunpowder with any one of its components; they also employed very fine sand (a substance closely allied in its physical characters to the powdered glass which Mr. Gale now proposes to use); but the preference appears to have been given to a particular form of carbon. It was not attempted altogether to prevent the burning of a mass of gunpowder when a spark or flame reached any portion, but to reduce the rapidity of combustion so greatly as to prevent the occurrence of a violent explosion. No more than this is accomplished by the employment of powdered glass in the proportions directed by Mr. Gale. Indeed, as the quantity of diluent required to give to different kinds of gunpowder the character of equally slow-burning materials, increases with the explosiveness of the particular powder and with the size of its grain, the proportion of powdered glass with which the gunpowder employed in rifled cannon would have to be mixed to render it only slow-burning, would be about double the quantity required for almost altogether preventing the ignition of fine-grain powder, or of the comparatively weak blasting powder with which Mr. Gale's public experiments appear generally to have been instituted. Although a sufficient dilution of gunpowder may secure such comparative safety to the neighbourhoods of large magazines, or to the crews of merchant-vessels in which gunpowder (for blasting purposes, &c.) is transported, as to compensate fully for the inconvenience attending the great increase of volume of the powder, there is no doubt that such a treatment of gunpowder actually issued for military and naval service would be attended by more than one serious obstacle—such as the tendency of the powder, unless very largely diluted, to separate from the glass, during transport by land or sea, to so considerable an extent as very greatly to diminish the degree of security originally aimed at; the very great addition which would have to be made to the arrangements for carrying the necessary ammunition in active service; the necessity for introducing, in the field or on board ship, the operations of separating the powder from the glass and transferring it to cartridges and shells (which, whatever sifting and other arrangements were adopted, would be time-taking and very dangerous), instead of preserving the ammuni-

tion ready for immediate use; and, above all, the incalculable mischief which would inevitably result from the establishment, in the minds of the soldier and sailor, of an erroneous feeling of security in dealing with gunpowder, which, however harmless it may for a time be rendered, must finally be handled by the men in its explosive form. The extremely rare occurrence of accidents with gunpowder, on board ship or in active land-service, is mainly due to the strictest enforcement of precautionary regulations, some of which may appear at first sight exaggerated or almost absurd, but which combine to maintain a consciousness of danger and a consequent vigilance indispensable to safety.

One of the most remarkable materials recently employed to replace gunpowder as a destructive agent is nitro-glycerine. This substance was discovered by Sobrero in 1847, and is produced by adding glycerine in successive small quantities to a mixture of one volume of nitric acid of sp. gr. 1·43, and two volumes of sulphuric acid of sp. gr. 1·83. The acid is cooled artificially during the addition of glycerine, and the mixture is afterwards poured into water, when an amber-coloured oily fluid separates, which is insoluble in water, and possesses no odour, but has a sweet, pungent flavour, and is very poisonous, a minute quantity placed upon the tongue producing violent headache which lasts for several hours.

The liquid has a specific gravity of 1·6, and solidifies at about 5° C. (40° F.); if flame is applied, nitro-glycerine simply burns; and if placed upon paper or metal, and held over a source of heat, it explodes feebly after a short time, burning with a smoky flame. If paper moistened with it be sharply struck, a somewhat violent detonation is produced. Alfred Nobel, a Swedish engineer, was the first to attempt the application of nitro-glycerine as an explosive agent, in 1864.

Some experiments were, in the first instance, made with gunpowder, the grains of which had been saturated with nitro-glycerine. This powder burnt much as usual, but with a brighter flame, in open air. When confined in shells or blast-holes, greater effects were, however, produced with it than with ordinary gunpowder; its destructive action is described as having been from three to six times greater than that of powder. The liquid could not be employed as a blasting agent in the ordinary manner, as the application of flame to it from a common fuze would not cause it to explode. But Mr. Nobel has succeeded, by employing a special description of fuze, in applying the liquid alone as a very powerful destructive agent. The charge of nitro-glycerine having been introduced, in a suitable case, into the blast-hole, a fuze, to the extremity of which is attached a small charge of gunpowder, is fixed immediately over the liquid. The concussion produced by the exploding powder upon ignition of the fuze effects the explosion of the nitro-glycerine.

The destructive action of this material is estimated, by those who have made experiments in Sweden and Germany, as about ten times that of an equal weight of gunpowder. Therefore, although its cost is about seven times that of blasting-powder, its use is stated to be attended with great economy, more especially in hard rocks, a considerable saving being effected by its means in the labour of the miners, and in the time occupied in performing a given amount of work, as much fewer and smaller blast-holes are required than when gunpowder is employed. The material appears to have recently received considerable application in some parts of Germany and in Sweden; but, in England, its employment has been confined to one set of experiments instituted in Cornwall last summer, upon which occasion a wrought-iron block, weighing about three hundredweight, was rent into fragments by the explosion of a charge of less than one ounce of nitro-glycerine placed in a central cavity.

Nitro-glycerine appears, therefore, to possess very important advantages over gunpowder as a blasting and destructive agent, but the attempts to introduce it as a substitute for gunpowder have already been attended by most disastrous results, ascribable in part to some of its properties and the evident instability of the commercial product, but principally to the thoughtlessness of those interested in its application, who appear to have been induced, either by undue confidence in its permanence and comparative safety, or from less excusable motives, to leave the masters of ships, or others who had to deal with the transport of the material, in ignorance of its dangerous character.

The precise causes of the fearful explosions of nitro-glycerine which occurred at Aspinwall and San Francisco will, in all probability, never be ascertained; but they are likely to have been due, at any rate indirectly, to the spontaneous decomposition of the substance, induced or accelerated by the elevated temperature of the atmosphere in those parts of the ships where it was stored. Instances are on record in which the violent rupture of closed vessels containing commercial nitro-glycerine has been occasioned by the accumulation of gases generated by its gradual decomposition; and it is at any rate not improbable that a similar result, favoured by the warmth of the atmosphere, and eventually determined by some accidental agitation of the contents of the package of nitro-glycerine, was the cause of those lamentable accidents. The great difficulties attending the purification of nitro-glycerine upon a practical scale, and the uncertainty, as regards stability, of the material even when purified (leaving out of consideration its very poisonous character and its extreme sensitiveness to explosion by percussion when in the solid form), appear to present insurmountable obstacles to its safe application as a substitute for gunpowder.

(To be continued.)

ACADEMY OF SCIENCES.

June 25.

M. Terreil presented "*An Analysis of a Piece of Rock forming a Part of the New Island of Santorin*," the composition of which approaches that of soda felspar:—

Silica	68·39	oxygen	36·19	
Alumina	15·07	,,	7·04	8·31
Peroxide of iron	4·26	,,	1·27	
Protoxide of iron	3·83	,,	0·85	3·15
Lime	3·19	,,	0·91	
Magnesia	0·70	,,	0·28	
Soda	3·86	,,	0·99	
Potash	0·73	,,	0·12	
Lithia	traces			
Nitrogenised organic matter	traces			
	100·03			

The traces of lithia were shown by the spectroscope, which revealed no trace of cæsium or rubidium.

M. L. Lartet presented a paper "*On the Deposits of Bitumen in Judea, and on the Asphalte of the Dead Sea.*" Travellers and geologists have been at a loss to account for the origin of the masses of asphalte, sometimes of considerable size, found floating on the water of the Dead Sea. M. Lartet believes in the existence of a series of hot springs which rise through bituminous limestone and bring up the asphalte.

Several papers besides the one mentioned above, on the wonderful volcanic phenomena still in progress around the island of Santorin, were presented; one, by M. da Corogna, related to "*the influence of the volcanic emanations on the health of men and plants.*" It can be easily imagined that a large quantity of ashes and of sulphuretted hydrogen thrown into the air might produce disagreeable effects, and we accordingly find that the population suffer more or less from conjunctivitis, bronchitis, and angina, and that the stomach and brain are

somewhat affected. Plants also appear to suffer from the action of hydrochloric acid, but the sulphuretted hydrogen seems to have benefited the vines, which have suffered from the oidium for the last ten years.

Other letters mention the appearance of two new islands on the last days of May, which the German geologists on the spot have named the Isles of May.

A report on M. Fouque's *Researches on the Chemical Phenomena of Volcanoes*, by M. Charles St. Claire Deville, was also presented. We have noticed the principal results of the author's investigations as they appeared, and need not refer to them again here.

There is a vacancy for a corresponding member in the Chemical Section of the Academy, to fill which Dr. Frankland has been selected.

THE BRITISH ASSOCIATION OF GAS MANAGERS.

On the Combustion of Gas for Economic Purposes. A Lecture delivered by Dr. Letheby.

(Continued from page 298)

The temperature of different combustibles is shown on the diagram below, and you will notice that the highest temperature produced by the various constituents of coal gas is that of acetylene, or the vapour of benzole when burned in oxygen, the heat of which exceeds 17,000° Fahr.; the lowest temperature of all the constituents is about 12,700° Fahr., the temperature of burning carbonic oxide.

On the same diagram I have tabulated the thermotic power of a great number of substances. It is expressed in the number of pounds of water raised 1° Fahr. by a pound of the substance, and when the body is capable of being converted into gas or vapour, I have also expressed it in the cubic foot at common temperaturea and pressures. Hydrogen, you perceive, is the most powerful thermotic agent, and carbonic oxide is the weakest; a pound of the first of these gases will raise 62,030 lbs. of water 1°, whereas a pound of the latter will only heat about 4325 lbs. of water to that extent. Examined by the cubic foot, and considering that for every pound of water raised 1°, about 48 cubic feet of air are raised to the same extent, we may say the chief constituents of coal gas have this thermotic power:—

Pounds of Water and Cubic Feet of Air raised 1° Fahr. by a Cubic Foot of the Gas Burning in Air.

Cubic Foot of		Lbs. Water. raised 1° Fahr.	Cub. Ft. Air raised 1° Fahr.
Hydrogen	heats	329	15,837
Marsh gas	,,	996	47,946
Olefiant gas	,,	1585	76,299
Propylene	,,	2376	114,378
Butylene	,,	3168	152,502
Acetylene	,,	1251	60,220
Benzole vapour	,,	3860	185,814
Carbonic oxide gas	,,	320	15,403
Common coal gas	,,	650	31,290
Cannel coal gas	,,	760	36,585

From this we can determine the practical thermotic power of any of these agents. A cubic foot of common gas will heat 65 gallons of water 1°, or 6·5 gallons 10°, or 3·25 gallons 20°; so that a bath containing 250 gallons of water would require about 77 cubic feet of common gas, or 66 of cannel, to raise its temperature from 55° to 75°. In practice, however, this is rarely attained, because of the faulty construction of the heating apparatus. I find, indeed, that a bath in my own house, made by Phillips, of Skinner Street, takes nearly twice this proportion of gas to heat it, and being in a closed room the atmosphere is almost poisoned before the bath is ready; and the circulation of the hot water is so imperfect that the top layer becomes boiling hot before the bottom of the water is warm. This is a subject which requires attention, for it is open to much improvement.

Again, with regard to the boiling power of gas, although in good practice a cubic foot of gas should boil off about 4712 grains of water, or about 22 times its own weight,

Table of the Combustion, Temperature, and Explosive Power of Gases.

	Per lb. substance.			Pounds of Water heated 1° Fahr.			Temperature of Combustion.				Explosive Power.		Mechanical power per lb.
							Open flame.		Closed Vessel.				
	Ox. used.	CO_2 produced.	Air vitiated.	Per lb. substance.	Per cubic foot substance.	Per lb. Ox. used.	With Ox.	With Air.	With Ox.	With air.	With Ox.	With Air.	Tons raised 1 ft. high.
	Cub. ft.	Cub. ft.	Cub. ft.	Lbs.	Lbs.	Lbs.	Deg.	Deg.	Deg.	Deg.	At.	At.	Tons.
Hydrogen	93·4	0·0	467	62030	329	7754	14510	5744	19035	7852	25·6	12·5	21390
Marsh gas	47·2	23·6	826	23513	996	5878	14130	4762	18351	6680	37·0	14·0	8108
Olefiant gas	40·5	27·0	878	21344	1585	6225	16535	5217	21344	7200	42·9	15·1	7360
Propylene	40·5	27·0	878	21327	2376	6220	16522	5239	21327	7177	67·3	22·5	7360
Butylene	40·5	27·0	878	21327	3168	6220	16522	5232	21327	7177	85·8	30·2	7360
Acetylene	36·3	29·1	909	18197	1251	5914	17146	5142	22006	7009	37·9	17·6	6275
Benzole	36·3	29·1	909	18197	3860	5915	17146	5142	22006	7009	113·7	52·8	6275
Carbonic oxide	6·7	13·5	371	4325	320	7569	12719	5358	16173	7225	21·8	11·7	1490
Bisulph. carbon	14·9	5·0	689	6120	1239	4845	15280	4314	20031	5917	30·2	11·6	2110
Sulph. hydrogen	16·7	0·0	630	7444	671	5271	13688	4388	17542	6026	28·3	12·7	2567
Cyanogen	14·5	14·5	435	6712	925	5142	13488	5028	17645	6167	35·6	17·8	2314
Common coal gas	37·5	17·6	618	21060	650	6816	14320	5228	18101	7001	29·2	14·6	7262
Cannel gas	31·0	22·0	698	20140	760	6503	14826	5121	19046	7186	38·8	18·0	6945
Wood spirit	25·3	11·8	422	9547	819	6363	11435	4641	14902	6347	40·3	15·3	3290
Alcohol	24·6	16·4	533	12929	1597	6195	13305	4831	17223	6629	46·3	16·1	4455
Ether	30·9	20·4	664	16249	3217	6158	14874	5150	19225	6953	58·6	19·0	5603
Camphine	38·9	27·8	880	19573	7134	5942	16271	5026	20953	6922	47·6	16·0	6750
Spermaceti	37·0	25·2	815	17589	...	6088	14599	4413	...	...	...	...	6065
Wax	37·7	25·6	829	15809	...	4995	12921	4122	...	...	...	...	5451
Stearic acid	34·6	24·0	783	17050	...	6061	15885	4818	...	...	...	...	5880
Stearin	34·4	14·2	527	18001	...	6143	15815	5095	.	...	...	...	6207
Paraffin	40·5	27·0	878	21327	...	6220	16522	5239	...	...	...	...	7354
Paraffin oil	40·5	27·0	878	21327	...	6220	16522	5239	..	...	...	...	7354
Rape oil	38·7	24·3	801	17752	...	6123	15830	5087	...	...	...	...	6121
Sperm oil	38·7	24·3	801	17230	...	6088	15363	4937	...	...	...	...	5941
Carbon	31·0	31·5	943	14544	...	5447	18329	3026	...	...	..	...	5015

yet this is not often attained, for in an open vessel we rarely evaporate more than 2866 grains of water, or about 13 times its weight.

But the heat of the burning gas is more surely applied to the warming of rooms; for, as you will see by the table, a cubic foot of common gas will heat an apartment containing 3129 cubic feet of air 10°, and the same quantity of cannel gas will heat 3658 cubic feet to the same extent. Other illuminating agents will, however, light for light, heat the atmosphere, and vitiate it to a larger extent. This is seen in the table which I brought under your notice at the last lecture.

Heating and Vitiating Effects of Different Illuminating Agents when Burning so as to give the Light of 12 Sperm Candles.

	Lbs. Water raised 1° Fahr.	Oxygen consumed, Cub. Ft.	Carb. Acid produced, Cub. Ft.	Air vitiated, Cub. Ft.
Cannel gas .	1950	3·30	2·01	50·2
Common gas .	2786	5·45	3·21	80·2
Sperm oil .	2335	4·75	3·33	83·3
Benzole . .	2326	4·46	3·54	88·5
Paraffin . .	3619	6·81	4·50	112·5
Camphine .	3251	6·65	4·77	119·2
Sperm candles	3517	7·57	5·77	131·7
Wax . .	3831	8·41	5·90	149·5
Stearic . .	3747	8·82	6·25	156·2
Tallow . .	5054	12·00	8·73	218·3

The vitiating effect is calculated on the actual loss of oxygen, and on the power which 4 per cent. of carbonic acid has on the vital qualities of the atmosphere; and, although the results indicate that there should be less discomfort in a room lighted with coal gas than with any other illuminating agent, yet common experience is altogether in the opposite direction. The explanation of this is to be found not only in the fact that gas is used more lavishly than other agents, but also that in burning it produces a larger proportion of aqueous vapour, which becoming diffused into the surrounding atmosphere occasions great discomfort. Professor Tyndall has shown that the molecules of aqueous vapour are endowed with a remarkable power of absorbing the radiant heat of burning gas, and by thus becoming warm they create a sense of oppression; and, again, when the warm atmosphere of a room is overcharged with moisture, it checks the action of vaporous or insensible perspiration, and this also causes distress. In all cases, therefore, where gas is largely used in rooms, provision should be made for the quick removal of the products of combustion.

When the heat of gas is required for warming a room, its radiant power should be increased by allowing it to ignite some solid substance, for the radiant heat of a non-luminous flame is very insignificant. I have here a Bunsen's burner, which gives with this gas the highest temperature of combustion, but the amount of heat which radiates from it is very small—smaller indeed than is the case when the gas is burnt in the ordinary way, when every atom of ignited carbon becomes a centre of radiation. The proportion of radiant heat from the same flame under different circumstances is very variable. From Bunsen's burner it is only 12, from the same gas burnt as a luminous flame it is 30, and with a spiral of platinum in it it is 85. The introduction of solid matter into a non-luminous flame of high temperature changes its character altogether, and from the heat of convexion it becomes heat of radiation. No doubt the quality of the vibrations is greatly changed, and they pass from the large and comparatively slow undulations of obscure heat to the small and quick vibrations of light; and the more this is effected, the greater and greater becomes the intensity of the radiant heat. Professor Tyndall found that the following were the quantities of radiant heat from a platinum spiral, at different degrees of luminosity:

	Degrees of Heat radiated.
Platinum spiral Feebly red . . .	19
,, ,, Dull red . . .	25
,, ,, Full red . . .	62
,, ,, Orange red . .	88
,, ,, Yellow red . .	158
,, ,, Yellow white . .	200
,, ,, Blue white . .	276
,, ,, Intense white . .	440

So that, when we wish to economise the radiant heat of burning gas, it is best to use it with some solid body, as fragments of pumice or pieces of asbestos.

The last point to which I would refer is the available or convertible motive power of burning gas.

The calculations of Dr. Mayer, of Heilbron, and the experimental inquiries of Mr. Joule, of Manchester, show that the mechanical power of heat is 772 lbs., raised a foot high for the heat necessary to raise the temperature of a pound of water 1° Fahr. A cubic foot of hydrogen in burning has therefore the mechanical power of (329 × 772 =) 253,988 lbs.; and the same quantity of common gas has the power of (650 × 772 =) 501,800 lbs.; while the power of a cubic foot of cannel gas is (760 × 772 =) 586,720 lbs., raised a foot high. But, if the same quantity of these gases is exploded with air or oxygen in a closed chamber, the mechanical power is somewhat different. I have here tabulated the expansive force of such a mode of combustion, and I may say that the calculations are deduced from the temperatures of combustion and from the volumes of the products—allowance having been made for the specific heats of the several products. It would seem, therefore, that the explosive powers of the several constituents of coal gas, when mixed with their proper proportions of air or oxygen, are as follows:—

Explosive Power of Mixed Gases.

	Mixed with Air. (Ats.)	Mixed with Ox (Ats.)
Hydrogen . .	12·5 . .	25·6
Marsh gas . .	14·0 . .	37·0
Olefiant gas . .	15·1 . .	42·9
Propylene gas . .	22·5 . .	67·3
Butylene gas . .	30·2 . .	85 8
Carbonic oxide . .	11·7 . .	21·8
Common gas . .	14·6 . .	29·2
Cannel gas . .	18·0 . .	38 8

These are the theoretical pressures exerted upon the sides of the containing vessel when these several gases are exploded with their proper proportions of air or oxygen; but as the explosion is never instantaneous, but proceeds from particle to particle, and therefore occupies time, and as the walls of the vessel always cool the products of the exploded gas to a great degree, this theoretical value is never obtained in practice, the highest pressure in the exploding chamber of a gas-engine being only 75lbs. on the square inch, or five atmospheres. The power of this has been determined experimentally by Mr. Evans, who informs me that with a cubic foot of a mixture of nine air and one gas he has propelled a wooden shot (three inches by four) 50 yards; and he ascertained that the same effect was produced with an ounce of gunpowder. The motive power, therefore, of the exploding mixed gas is considerable.

In the gas-engines of Lenoir it has been found that the best proportions of air and gas are eight volumes of air to one of common gas; theoretically the best proportion for London (13-candle) gas is 5·6 volumes of air to one gas. A larger portion of air is required for cannel gas, as 11 to 1; but in practice it is found that cannel gas does not produce so good an effect as common gas. The time of

the explosion is about the 27th part of a second, and the temperature of it is about 2474° Fahr. instead of from 5228° to 7000°—the calculated temperatures for open and closed chambers.

The machines which are used for practically employing this power are all modifications of the original engine of Lenoir. They consist of a cylinder with a double-action piston, receiving the mixed gas alternately on either side of the piston. The arrangement is such that in the movement of the piston the air and gas, in proper proportions (8 to 1), are drawn into the cylinder by a suitable side valve, and when the piston has made half a stroke it shuts off the valve; at that moment the mixed gas is fired in the cylinder by means of an electric spark from a Ruhmkorff's coil passing between the points of two wires in the cylinder. One of these wires is insulated by traversing a rod of porcelain fixed in the cylinder, and, being in connexion with a make-and-break contrivance, called a distributor, attached to the fly-wheel of the engine, it receives the charge of electricity, and so fires the mixed gas at the right moment. The expansion caused by the explosion and heat of combustion drives the piston through the rest of the stroke, and it generally ends with a good deal of unutilised pressure. In one case I find that the indicator recorded an initial pressure of 75 lbs. on the inch at the moment of explosion, and a final pressure of 25 lbs. The loss of power in this case must have been considerable, for not only is there the loss of the difference (12·5 lbs.) between the calculated pressure 37·5 lbs. (75÷2), and the real (25), but there is also the total loss of the unavailable final pressure. A part of this loss is no doubt due to leakage, and to the cooling effect of the walls of the cylinder, for the temperature has been observed to fall from 2474° Fahr. at the moment of explosion to 1438° at the end of the stroke—the calculated temperature being 2156°; indeed the management of the temperature is one of the difficulties of the engine, for the cylinder has to be cooled by a stream of water. Improvements will no doubt be made in the construction of the engines, and especially in the utilisation of the residual power, and this must be done by shutting off the valve and firing the gas earlier in the stroke. This has already been done to some extent in America with engines of half-horse power, as with cylinders of $4\frac{3}{8}$ inch diameter by $8\frac{3}{4}$ inch stroke; and this with 185 revolutions or 370 explosions in a minute raises 16,280 lbs. one foot high in a minute. In France and in this country much larger engines are made, as from 1 to 3 horse power.

The quantity of gas used in the working of the engine is rather variable. In the American engine, already alluded to, it took 105 cubic feet of gas an hour to work an engine of half-horse power, and a one-horse engine in London takes about 185 cubic feet of London gas—say it is 200 cubic feet—per horse power. This is 1,980,000 lbs. a foot high; whereas the theoretical power of 200 feet is more than 100 millions of pounds.

The advantages of the engine are very great, for it takes up but little room, it is very clean, it works with great regularity, it requires little or no attention, and it costs nothing for fuel when it is not at work.

One thing I ought to mention in speaking of the explosive power of mixed gas, and that is the effect of using mixtures in improper proportions. Sir Humphrey Davy found, in his experiments with marsh gas, that there was but one proportion of air and gas which gave the maximum effect, and that was a mixture of 1 of gas and 7·5 of air (theoretically it should be 1 to 9·5). When the proportions are reduced in either direction the mixture becomes less and less explosive, until with 1 gas and 15 air, or with equal volumes of gas and air, the mixture ceases to explode.

In the case of coal gas, although the theoretical proportions for London gas are 1 of common gas* to 5·6 of air, and 1 of cannel gas to 7·4 of air, yet the best results are obtained with 1 of the former to 8 of air, and 1 of the latter to 11. On either side of this proportion the mixture rapidly becomes less and less explosive.

The effect of mixing other gases with explosive mixtures has been well studied by Davy and others; taking, for example, an explosive mixture of 2 volumes of hydrogen and 1 of oxygen, it is found that 1 of nitrogen to 6 of the gas, or 1 of carbonic acid to 7 of it, will stop its explosion.

Lastly, the temperature at which these gases are fixed is a matter of considerable importance. Davy found that he could not set fire to marsh gas (the firedamp), or to an explosive mixture of it with air, by using the strongest heat of glowing charcoal. He even blew a mixture of the gas upon glowing charcoal until he got it at a maximum heat without firing it; nor can it be fired by the sparks from flint and steel. Not so, however, with hydrogen, or olefiant gas or carbonic oxide, all of which are fired by the sparks and by glowing charcoal—perhaps the igniting temperature is about 3900° Fahr.; and the vapour of bisulphide of carbon is fired at as low a temperature as 300° Fahr. These facts are deserving of attention, for they show that gas leaking from the mains may be fired by a spark from a pick, or from the chipping of a hole in the pipe in laying a service.

And now, gentlemen, we have gone over the question of the phenomena of gaseous combustion, and of the manner in which gas is to be most profitably and most economically used for illuminating purposes. We have also examined the thermotic powers of coal gas, and I hope if I have the opportunity of meeting you again, I shall be able to bring under your notice one other question of interest to gas engineers, and that is the profitable utilisation of the waste products of gas-works.

NOTICES OF BOOKS.

A Companion to the British Pharmacopœia: comparing the Strength of the Various Preparations with those of the London, Edinburgh, and Dublin, United States, and other Foreign Pharmacopœias, with Practical Hints on the Art of Prescribing. By PETER SQUIRE, F.L.S., Chemist on the Establishment of the Queen, &c., &c. Third Edition. London: Churchill and Sons. 1866.

WE must heartily congratulate Mr. Squire on the appearance of this, the third, edition of a book which we pronounced to be the best of the many published as companions and guides to the British Pharmacopœia. We can only repeat what we said of the second edition, that the author has made the best book still better. Very considerable additions, and those of very useful matter, have been made to this edition. Since the publication of the last a new Prussian Pharmacopœia has been issued, and the portions of the work in which the last Prussian Pharmacopœia was quoted have been carefully corrected to the most recent edition.

It is impossible to notice the additions which have been made; they occur on every page. But we may say that we have not observed one that does not add to the value of the work. Many of them are devoted to non-officinal preparations, and the pharmaceutist will well understand that

* Average Composition of London Gas by Volume.

	Common Gas.	Cannel Gas.
Hydrogen	46·0	27·7
Light carburetted hydrogen	39·5	50·0
Olefiant, &c.	3·8	13·0
Carbonic oxide	7·5	6·8
Carbonic acid	0·7	0·1
Aqueous vapour	2·0	2·0
Nitrogen	0·5	0·4
	100·0	100·0

these, made by an author with unusually good sources of information at command, will contain the best information on recent progress in pharmacy.

The book, too, may be equally commended to the notice of medical men; for the practical hints on prescribing scattered about the pages show an excellent knowledge of the uses of medicines, as well as of their incompatibilities. In short, this is the best work of the kind we know both for pharmaceutist and prescriber.

Annales de Chimie et de Physique. June, 1866.

We have in this journal the second part of M. Kolb's "*Theoretical Study of Leblanc's Process,*" in which the author examines the changes which take place during the digestion and lixiviation of black ash. There is much useful information for the manufacturer in the tables in which the author shows the influence of the proportion of water in the results of the digestion, as well as the duration of the digestion, and also the influence of temperature on the result, and we are sorry that the large space they occupy will prevent us from giving the whole series. In a future number, however, we shall give the most important features of them. The tables show that in a cold concentrated liquor, and in the presence of a little caustic soda, no reaction takes place between the sulphide of calcium and the carbonate of soda in the course of a short digestion. Hence the object of the manufacturer must be to lixiviate with as little water and at as low a temperature as possible. The great want, the author suggests, is an apparatus which shall effect the exhaustion of the ash in a few hours with a small quantity of cold water.

There is another original memoir by M. Joseph Boussingault, "*On the Manufacture of Kirschenwaeser,*" which is of no interest to English chemists.

NOTICES OF PATENTS.

We have on several occasions urged the advisability of appointing scientific examiners to investigate the claims of an invention to novelty, upon which alone we have argued the grant of the protection of a patent should depend, time alone being able to decide on the utility. Among the recently-published specifications we find two or three inventions (?) which well illustrate the necessity for such an examination. It is true that in most of these instances only a provisional protection has been obtained, and the inventors therefore have only had the privilege of paying five pounds to the Government, and their agents' fees. Why their patents have not been completed we have no means of knowing, but we may feel tolerably certain that it was simply because they doubted their chances of making money by them. The Attorney-General, we dare say, would have raised no obstacle if the inventors had been ready with their fees.

The first of these specifications we may notice is the following:—

"Generating Oxygen Gas.

"*Provisional Specification left by Hermann Beigel at the Office of the Commissioners of Patents, with his Petition, on July 6, 1865.*

"I, Hermann Beigel, of Finsbury Square, in the County of Middlesex, do hereby declare the nature of the said invention for 'Improvements in the Means of Obtaining or Producing Oxygen, applicable to various Useful Purposes,' to be as follows:—

"This invention relates to certain improvements in the means or method of producing or generating oxygen gas, applicable to a variety of useful purposes, the process being cheaper than any other hitherto in use for the purpose.

"I propose by this invention to take a concentrated or saturated solution of chloride of lime, to about 100 pounds of which I add about half an ounce of oxide or salt of nickel or cobalt, the result of this admixture at a temperature of about 80 degrees Reaumur being that chloride of lime is decomposed into chloride of calcium and oxygen, the oxygen being eliminated and set free from the lime; and if the process is effected in a closed vessel, a tube or pipe will conduct the gas as required.

"I also propose to mix the ingredients in the dry state, and to eliminate the oxygen from the lime by the addition of water, so that the powder may be packed and rendered easily portable and ready for use. In this process there is no danger, as is the case in some others where great heat is employed or compounds are used which are liable to explosion; pure oxygen is obtained, there is no difficulty in working, great quantities of oxygen can be quickly produced, and the facility of production affords a more general means of application. The process should be conducted with warm water, or water at a temperature of about 90 degrees, to urge the elimination. The oxygen gas may be used to aerate or oxygenate water and other liquids, to purify air in hospitals, mines, ships, and elsewhere, in which cases an open vessel may be employed. But for inhalation or aerating waters the process should be conducted in a closed vessel. The gas is also applicable to the generation of light for lighthouses and other situations where signals are required. By adding fresh quantities of chloride of lime, the generation of oxygen may be continued without the addition of cobalt or nickel, which undergo no change during the process."

The date of this specification, it will be seen, is July 6, 1865. But the readers of the Chemical News will, perhaps, remember that in our journal for May 19, 1865, there was a notice of the *Annalen der Chemie und Pharmacie* for April which contained an account of this very process by the true inventor Fleitmann; and the Chemical News of the following week contained a full translation of the paper. The specification has nothing on the face of it to show that the invention was "a communication," and we are therefore left to the conclusion that Mr. Hermann Beigel claimed it as his own. The mixing of the dry ingredients, perhaps, was Mr. Hermann Beigel's invention; but the process is beyond all doubt Fleitmann's, and by what right Mr. Beigel presumed to take it to the Patent Office we are quite at a loss to conceive.

We pass to another specification of a process for the production of oxygen:—

"*Provisional Specification left by Hector Auguste Dufrené at the Office of the Commissioners of Patents, with his Petition, on July 11, 1865.—A communication from Monsieur Charles Tellier, residing at Passy, Paris, in the Empire of France.*

"I, Hector Auguste Dufrené, do hereby declare the nature of the said invention for 'An Improved Process for Obtaining Oxygen' to be as follows—that is to say:—

"The object of the invention is to employ oxygen for industrial purposes, and, as it does not exist in a commercial state, to obtain it economically. To attain this object I produce the following reactions:—When a current of dried chlorhydric acid and air is passed over pumice-stone at a red heat in a suitable apparatus, decomposition of the acid takes place. The hydrogen unites with the oxygen of the air to form water, and azote and chlorine, which may be easily separated, can be collected. When on the contrary a mixture of chlorine and water steam is passed through a tube heated to red heat, decomposition again takes place, but in this instance the hydrogen combines with the chlorine, and oxygen is set at liberty. The furnaces employed for these operations may vary in form according to circumstances; I do not therefore lay claim to any kind of furnace which may be employed.

"It will be easily understood from the preceding reactions that a very large quantity of azote is eliminated in the operations. To utilise this gas I pass it over iron in a spongious state heated to a red heat, by which the azote is absorbed. In these conditions I cause hydrogen to be brought on the

combination of azote and iron thus formed; the decomposition is immediate, and the large quantity of ammonia so produced causes the reduction of the price of oxygen. This gas being thus produced I apply it principally to the production of heat and light by burning in this gas several substances, but especially metals. I propose also to take advantage of the excessive heat resulting from this combustion to melt iron, and apply it either for moulding, or for preparing moulds in which iron can be run in and cast, and also for preparing ingots for the forge. I can also burn in this gas sulphurous cast iron, and obtain pure oxide easily reducible. Zinc produces a greater heat than iron, and in certain cases it should be preferred, especially in that which concerns light, which will give the best results, in consequence of the solid particles produced by its combination with oxygen. The oxide formed in both cases is reduced by the ordinary means."

M. Dufrené, it will be seen, is more candid than Mr. Beigel. He ascribes the invention to the fertile brain of M. Tellier, but what right has even the last-named gentleman to patent the decomposition of steam in contact with chlorine?

There is something highly amusing in this specification. Supposing for a moment such a patent valid, claims for half a dozen different things might be founded upon it. The chemistry also is remarkable. The elimination of azote in the reaction of chlorine on steam is scarcely worthy of M. Tellier; but as all this gentleman's thoughts are directed to the production and utilisation of ammonia the confusion is not surprising.

We need not detain our readers longer over these *inventions*; and we only quote them because we know of nothing in our present patent law to hinder the actual completion of such patents.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

1493. J. D. Whelpley and J. J. Storer, Boston, Mass., U.S.A., "An improved process and apparatus for obtaining metals and saleable products from ores and minerals, adapted particularly to the reduction of sulphurets."—May 29, 1866.

1522. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the deodorising of crude rock or mineral oil, and in the preparation of lubricating oil therefrom."—A communication from J. Mott and G. Cowles, Lindsay, Canada West.—May 31, 1866.

1555. C. A. McEvoy, Bedford Square, Middlesex, "Improvements in shells, and in fuses used with shells."—June 5, 1866.

1559. W. Lawrence, Cornwall Road, Paddington, Middlesex, "Improvements in the manufacture of malt, and in apparatus for drying malt and hops."

1560. W. Lawrence, Cornwall Road, Paddington, Middlesex, "Improvements in the manufacture of and apparatus for the treatment of worts."—June 6, 1866.

Notices to Proceed.

582. J. L. Pulvermacher, Oxford Street, Middlesex, "Improvements in means and apparatus for producing and applying galvanic currents."—Petition recorded February 24, 1866.

603. H. Robertson, Motherwell, Lanarkshire, N.B., "Improvements in the manufacture of oil and other products from bituminous substances, and in the machinery or apparatus employed therein, which improvements, or parts thereof, are also applicable to the manufacture of white lead or other pigments."—February 27, 1866.

615. H. A. Dufrené, Rue de la Fidélité, Paris, "Improvements and new applications in the manufacture of beer and alcoholic liquids."—A communication from C. Tellier, Rue Boulainvilliers, Passy, Paris.—Feb. 28, 1866.

667. J. Gray, Glasgow, N.B., "Improved preparations for acting upon sea water, or upon hard or impure water, in order to render such water more suitable for use in boilers and otherwise."—March 5, 1866.

MISCELLANEOUS.

The New Pharmacopœia.—The following Report was presented by the Pharmacopœia Committee at the recent sitting of the Medical Council:—

"The Pharmacopœia Committee have to report that since the date of their last Report Messrs. Redwood and Warington have continued to be engaged in the duty assigned to them, and they have so far completed their work that the whole of the matter, with the exception of the Appendix, is now in type. The Committee have reason to hope that the volume will be ready for circulation, in proof, amongst the members of Council in three months from the present time. Under these circumstances the Committee beg leave to direct the attention of the Council to the resolution adopted at the meeting of last year (Minutes, vol. iii., p. 285), as follows:—

"'That it is desirable to have a proof copy of the new Pharmacopœia in the hands of the members of the General Medical Council at least one month before the meeting of the General Medical Council, at which the opinion of the Medical Council is to be given relative to its being published, in order to afford to each member of Council the opportunity of making such suggestions to the Committee as may appear desirable.'

"As the Committee anticipate that the work will be ready some considerable time before the next ordinary general meeting of the Council, the Committee would wish to receive such further directions as the Council may feel it necessary to give them on this subject. The Committee, before concluding their Report, desire, in reference to an impression which seems to prevail that some unnecessary delay has taken place in the production of the Pharmacopœia, to assure the Council that no time has been spent in the work which was not necessary.

"The Committee beg to inform the Council that they have not hitherto had occasion to draw upon the fund placed at their disposal by order of the Council. (Minutes, vol. iii., p. 285.)

"May 21, 1866." "R. Christison, Chairman.

The Chemical Society and the Pharmacopœia.—The following letter respecting the notation to be adopted in the new Pharmacopœia was sent to the Medical Council by the Chemical Society:—

"To the President of the General Council of Medical Education and Registration.

"Burlington House, March 19, 1866.

"Sir,—The President and Council of the Chemical Society venture to call the attention of the Medical Council to the system of chemical notation adopted in the British Pharmacopœia; and, as they are informed that a new edition of that Pharmacopœia is in course of preparation, they entertain a hope that it may not be an inopportune moment to urge upon the Medical Council the desirableness of considering whether, in the forthcoming edition of the work, the use of chemical symbols could not be advantageously dispensed with altogether. In the few cases which may seem specially to call for the use of such formulæ, a percentage representation of the composition of the body would, it appears, supply all the necessary data.

"The grounds on which the President and Council of the Chemical Society have been induced to suggest this course are these:—

"The system of notation at present adopted in the British Pharmacopœia is constructed in conformity with views which are rapidly disappearing from chemical teaching in this country.

"The Pharmacopœia is necessarily the text-book on which the examinations of students of medicine and pharmacy in pharmaceutical chemistry are based. It appears, therefore, extremely desirable that no work shall be put forth on official authority, such as that of the Medical Council, which shall be at variance with the views propounded by many of the most active experimental leaders and principal teachers of chemical science, or which shall oblige the teacher to adopt a double numerical system in his exposition of the facts of chemical science to his pupils—a course which is always a source of embarrassment both to professor and learner.

"It is obvious that the adoption of a plan such as the one now suggested does not necessitate any expression of opinion on the part of the Medical Council upon a subject which is still under discussion. At the same time it will relieve the Council from the inconvenience of appearing pledged to the maintenance of doctrines which are no longer believed to be correct by many of the most competent to form an opinion on the subject.

"The President and Council of the Chemical Society trust that the importance of the subject will sufficiently explain their anxiety to bring this matter under the consideration of the Medical Council.

"WM. ALLEN MILLER,
"President of the Chemical Society."

Some discussion on the subject followed the reading of this communication, and eventually the following resolution was passed by the Council:—

"That it be an instruction to the Pharmacopœia Committee to give for each therapeutic compound, of definite constitution, occurring in the forthcoming edition of the Pharmacopœia, two formulæ—the first being that in ordinary use at present, the second being one constructed in accordance with the more recent views of what is called the 'unitary system.'"

Analysis of the Metropolitan Waters for June, by Professor Frankland, F.R.S., of the Royal College of Chemistry:—

Companies.	Number of houses supplied in May, 1866.	Average daily supply of water in gallons during the month of May, 1866. (See Note.)	Solid matter in 100,000 parts of the waters.	Organic and other volatile matter included in column 4.	Amount of oxygen required for oxidation of organic matter.	Total hardness.
Thames.						
Chelsea	26,463	7,385,800	25·25	0·85	·0360	16·5
West Middlesex	35,707	8,397,709	24·82	0·97	·0360	16·2
Southwark and Vauxhall	73,809	12,175,000	24·74	0·93	·0420	15·7
Grand Junction	25,636	8,855,729	24·82	0·91	·0368	16·2
Lambeth	36,008	8,904,800	26·63	1·01†	·0424	16·8
Other Sources.						
Kent	32,766	6,025,420	39·28	1·50	·0076	25·4
New River	111,958	23,092,000	21·55	0·91	·0252	13·7
Ditto (after filtration through animal charcoal)	—	—	19·57	0·30	·0072	9·5
East London	88,340	18,357,000	26·22	1·26	·0264	15·7
South Essex	750	160,000	38·52	1·66	·0080	23·1

Note.—The water includes the supply for manufactures and for various purposes other than domestic consumption. This return, as compared with that for the previous month, shows an increase of 267 houses and an increase of 3,688,005 gallons of water supplied daily.

The table may be read thus:—100,000 pounds of the Chelsea water contained 25·25 lb. of solid matter, of which 0·85 lb. of organic and other volatile matters was driven off by incineration. 0·0360 lb. of oxygen was required to oxidise the organic matter in the said quantity of Chelsea water. Of the solid matter 16·5 lb. were carbonate of lime or its equivalent of hardening salts.*

The fourth column of this table contains the amount of solid matter left on evaporation and desiccation at 120 deg. C.—130 deg. C. (248 deg F.—266 deg. F.)

The results are recorded in 100,000 parts. By moving the decimal point one place to the right the above figures express in milligrammes the quantities contained in one kilogramme of the several waters. The whole of the waters were free from turbidity when drawn from the companies' mains.

Composition and Quality of the Metropolitan Waters in June, 1866.—The following are the Returns of the Metropolitan Association of Medical Officers of Health:—

Names of Water Companies.	Total solid matter per gallon.	Loss by ignition.*	Oxidisable organic matter.†	Hardness.	
				Before boiling.	After boiling
Thames Water Companies.	Grains.	Grns.	Grains.	Degs.	Degs.
Grand Junction	18·05	0·67	0·62	13·5	3·0
West Middlesex	17·02	0·71	0·40	13·0	3·0
Southwark & Vauxhall	18·12	0·68	0·62	13·5	4·0
Chelsea	17·73	0·74	0·48	13·5	3·5
Lambeth	18·60	0·80	0·72	13·5	3·0
Other Companies.					
Kent	28·23	1·00	0·00	17·5	8·0
New River	16·06	0·56	0·14	12·0	3·0
East London	17·70	0·94	0·23	12·5	4·0

* The loss by ignition represents a variety of volatile matters, as well as organic matter, as ammoniacal salts, moisture, and the volatile constituents of nitrates and nitrites.

† The oxidisable organic matter is determined by a standard solution of permanganate of potash, the available oxygen of which is to the organic matter as 1:8; and the results are controlled by the examination of the colour of the water when seen through a glass tube two feet in length and two inches in diameter.

H. LETHEBY.

Royal Commission on the Coal Question.—The following appeared in Tuesday's *Gazette*:—"The Queen has been pleased to appoint the Most Noble George Douglas, Duke of Argyll, K.T.; Sir Roderick Impey Murchison, Bart., K.C.B.; Sir William George Armstrong, Knight, C.B.; Henry Hussey Vivian, Esq.; George Thomas Clark, Esq.; Joseph Dickinson, Esq.; George Elliot, Esq.; Thomas Emerson Forster, Esq.; John Geddes, Esq.; Robert Hunt, Esq.; John Beete Jukes, Esq.; John Hartley, Esq.; John Percy, Esq., Doctor of Medicine; Joseph Prestwich, Esq.; Andrew Crombie Ramsay, Esq.; and John Thomas Woodhouse, Esq., to be her Majesty's Commissioners to investigate the probable quantity of coal contained in the coal fields of the United Kingdom, and to report on the quantity of such coal which may be reasonably expected to be available for use: whether it is probable that coal exists, at workable depths, under the Permian New Red Sandstone, and other superincumbent strata; to inquire as to the quantity of coal at present consumed in the various branches of manufacture, for steam navigation, and for domestic purposes, as well as the quantity exported; and how far, and to what extent, such consumption and export may be expected to increase; and whether there is reason to believe that coal is wasted, either by bad working or by carelessness or neglect of proper appliances for its economical consumption."

ANSWERS TO CORRESPONDENTS.

W. L. R. writes:—"Can you or any of your readers kindly inform me what quantity of sulphuric acid 1750 can practicably be made from one ton of Irish ore containing 30 per cent. of sulphur?"—We have no time to make the calculations for the theoretical quantity. Perhaps some reader may like to amuse himself with the question.

A Colour Maker.—We do not know of a book on the naphthaline and phenyle colours, but "Die Entwickelung der Anilin-Industrie," by Dr. Max Vogel, appears to be a good practical work on the aniline colours.

J. R. P.—The last series are only published in the *Transactions* of the Belgian Academy at present, but we shall commence immediately a tolerably full translation. The first series will be found in the fourth volume of the CHEMICAL NEWS.

Books Received.—"The Negro and Jamaica," by Commander Bedford Pim, R.N.; "Lessons in Elementary Chemistry," by H. E. Roscoe, B.A., F.R.S.

* The degree of hardness hitherto employed by chemists is that first proposed by Dr. T. Clark, viz., one grain of carbonate of lime, or its equivalent of hardening salts, in one imperial gallon of water, or one part in 70,000. The degrees of hardness used in the above table are readily converted into Clark's degrees by multiplying by seven, and then moving the decimal point one place to the left.

† By mistake, this number was given as 2·14 in the Report of the Registrar-General.

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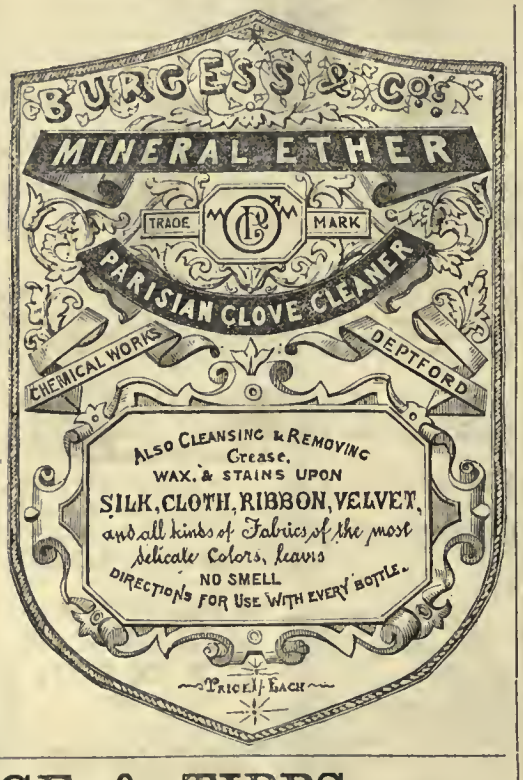

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AND

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

An Introduction to Chemical Philosophy, according to the Modern Theories, by Adolphe Wurtz, *F.R.S.*

Part III.

Connexion between Organic and Inorganic Chemistry.

Section I.— *Atomicity as a Means of Classification.*

(*Continued from vol.* xiii., *page* 302.)

The reasoning which we have applied to atomicity establishes a solid relationship between organic and inorganic chemistry. Struck with the fact that the atoms of carbon, hydrogen, and oxygen could be heaped up in organic compounds so as to form very complex molecules, chemists were of opinion that this peculiarity impressed a special stamp upon the combinations of carbon. But it is not so, and it is easy to show that the property in question is displayed in other polyatomic elements. This accounts for the complication of the combinations of silicium, which may be compared, on this point, to the combinations of carbon. Why, then, is the chemistry of silicium so different from that of carbon? It arises from these two circumstances—that, on the one hand, silicium forms with oxygen a fixed compound; and, on the other hand, that its affinity for hydrogen seems to be exhausted in a single combination, which cannot exist in presence of air, since it is spontaneously inflammable.

Without carbides of hydrogen there would be no organic chemistry; and if there existed silicides of hydrogen corresponding to the carbides, it is clear that the bodies derived from these silicides might be very numerous. But it is none the less true that the natural silicates often show great molecular complication, and may be compared, in this respect, to the organic compounds of carbon. And the reason of such a molecular complication is contained, as we will show, in the polyatomic nature of silicium and of certain of the metals which are united with this element in the silicates. Our investigations upon atomicity establish, between compounds otherwise very unlike in nature and properties, connexions in constitution or molecular structure which it is desirable to point out. They allow of convenient grouping together, and furnish, both for inorganic and organic chemistry, elements of classification that it would in future be impossible to neglect. Our task shall be further to develope these points.

A celebrated chemist has said*:—"Organic chemistry is the chemistry of the compound radicals." We know now that such radicals do not belong exclusively to organic combinations; but, as regards their power of combination, we know that they act as elements. We have then the right to compare, with respect to their atomicity, the radicals of organic chemistry, not only to the compound radicals but also to the simple elements of inorganic chemistry. As in organic chemistry we find monoatomic, diatomic, triatomic radicals, &c., so also in inorganic chemistry we find radicals and elements of different atomicity, and it is evident that inorganic and organic combinations containing radicals or elements of the same atomicity should present a certain analogy of structure, which might show itself by a certain analogy in their reactions. For simple as well as for compound bodies their atomicity is the principal means of classification. The natural families of metalloids established by M. Dumas† are groups of simple bodies of equal atomicity:—

Monatomic.	Diatomic.	Triatomic.	Tetratomic.	Triatomic and pentatomic.
Fluorine.	Oxygen.	Boron.	Carbon.	Nitrogen.
Chlorine.	Sulphur.		Silicium.	Phosphorus.
Bromine.	Selenium.			Arsenic.
Iodine.	Tellurium.			Antimony.

Similar groups might be formed among the metals, and these classifications are much better founded than the artificial relationships established between the metals by their degree of affinity for oxygen.

It must be allowed that, in a large number of cases, the classification formerly adopted by Thenard breaks the natural connexions established between the metals by the general composition of their combinations. It is thus, for example, with silver, which is monoatomic, and which should be placed along with the alkaline metals.

The following is this very natural group of monoatomic metals:—

Hydrogen.

Rubidium.
Cæsium.
Potassium.
Sodium.
Lithium.
Silver.

Thallium.

Lead should be classed with the diatomic metals barium, strontium, calcium. To this group would be joined the diatomic metals isomorphous with the magnesian series, magnesium, manganese, iron, zinc, &c. The tetratomic metals form a very natural group. It is convenient to place them after silicium. We have thus the following family:—

Carbon.
Silicium.

Zirconium.
Titanium.
Tin.
Tantalum.

Niobium.

But it must be added that in this attempt at classification, as in all attempts of this character, difficulties are encountered arising from the circumstance that among the metals, even more than among the metalloids, each element bears the impress of a strongly marked individuality. It shows certain points of contact with its neighbours with regard to some combinations, but seldom a complete analogy in every combination. Thus thallium, which in some points resembles the alkaline metals, differs from them in the property it possesses of forming a sesquichloride and a terchloride. Iron, which, when considered in the ferrous combinations, resembles manganese and zinc, should be classed with aluminium when it is considered in the ferric combinations. Copper, which shows a point of contact with the magnesian series in the cupric combinations, also, to a certain point, resembles mercury. The general composition of the cuprous and mercurous, cupric and mercuric oxides and chlorides is the same.

If from simple we pass to compound bodies, we shall see that the notion of atomicity allows us to establish

* Liebig, "*Traité de Chimie Organique*," vol. i., p. 1.

† Dumas, "*Traité de Chimie appliquée aux Arts*," vol. i., p. lxxvii., 1828.

very curious, and often very unexpected, relationships between certain inorganic and organic compounds.

Section II.—*Oxides, Hydrates, and Salts, Inorganic and Organic.*

Let us first take the oxides and the hydrates. We know that Berzelius likened the oxidised bodies of organic chemistry to the inorganic oxides and acids. He looked upon acetic acid as the teroxide of an acetyle radical (C_4H_6 in his notation), and compared it to sulphuric acid.

$(C_4H_6).O_3$ Acetic acid.
$S.O_3$ Sulphuric acid.

Comparing ether to oxide of potassium, he called it oxide of ethyl, and this name has remained to it, for the comparison was very reasonable. It has, in fact, been found that ether can enter into direct combination with the acids. Dr. Wetherill, in 1848, obtained sulphate of ethyl (sulphatic ether) by directly combining oxide of ethyl with anhydrous sulphuric acid. Afterwards M. Berthelot prepared other compound ethers by combining ether directly with the acids.

Thus oxide of ethyl and its homologues were found to resemble oxides not merely by the symbolic representation of their composition, but also by a certain analogy of properties. But it must be owned that this analogy was not of a very striking nature, the affinities of oxide of ethyl being very far from equalling those of the mineral oxides. This is not the case with the oxide of ethylene, whose reactions are much more energetic, and which is able to enter into direct combination, not only with the acids, but also with water and ammonia, like certain metallic oxides. Oxide of ethylene

$(C_2H_4)''\Theta$

contains the diatomic radical ethylene, and we can compare it to the oxides formed by the diatomic metals. We are thus led to establish the following parallel between the oxides of inorganic and those of organic chemistry :—

Monatomic oxides.	Diatomic oxides.	Triatomic oxides.	Tetratomic oxides.
$\left.\begin{matrix}K\\K\end{matrix}\right\}\Theta$ Oxide of potassium.	$Ca''\Theta$ Oxide of calcium.	$\left.\begin{matrix}Sb'''\\Sb'''\end{matrix}\right\}\Theta_3$ Oxide of antimony.	iv. ZrO_2 Oxide of zirconium.
$\left.\begin{matrix}Na\\Na\end{matrix}\right\}\Theta$ Oxide of sodium.	$Zn''\Theta$ Oxide of zinc.	$\left.\begin{matrix}Bi'''\\Bi'''\end{matrix}\right\}\Theta_3$ Oxide of bismuth.	iv. SnO_2 Stannic acid.
$\left.\begin{matrix}Ag\\Ag\end{matrix}\right\}\Theta$ Oxide of silver.	$Cu''\Theta$ Oxide of copper.		iv. TiO_2 Titanic acid.
	$(C_2H_4)''\Theta$ Oxide of ethylene.	$\left.\begin{matrix}(C_3H_5)'''\\(C_3H_5)'''\end{matrix}\right\}\Theta_3$ Oxide of glyceryle.	iv. NbO_2 Niobic acid.
$\left.\begin{matrix}(CH_3)'\\(CH_3)'\end{matrix}\right\}\Theta$ Oxide of methyl.	$(C_3H_6)''\Theta$ Oxide of propylene.		iv. TaO_2 Tantalic acid.
$\left.\begin{matrix}(C_2H_5)'\\(C_2H_5)'\end{matrix}\right\}\Theta$ Oxide of ethyl.	$(C_5H_{10})'\Theta$ Oxide of amylene.		
$\left.\begin{matrix}(C_3H_5)'\\(C_3H_5)'\end{matrix}\right\}\Theta$ Oxide of allyle.			

Thus, as we have above remarked, oxide of ethylene combines directly with water to form glycol or hydrate of oxide of ethylene. This reaction is similar to the direct hydration of lime, and leads us to compare glycol to hydrated lime.

$$(C_2H_4)''\Theta + H_2\Theta = \left.\begin{matrix}(C_2H_4)''\\H_2\end{matrix}\right\}\Theta_2$$

Oxide of ethylene. Hydrate of ethylene.

$$Ca\Theta + H_2\Theta = \left.\begin{matrix}Ca''\\H_2\end{matrix}\right\}\Theta_2$$

Oxide of calcium. Hydrate of calcium.

Alcohol itself has long been compared to hydrate of potassium, although no one has yet succeeded in obtaining it by directly combining the elements of water with oxide of ethyl. But the resemblance in question is founded on the analogy of the reactions which acids exercise both upon hydrate of potassium and upon alcohol or hydrate of ethyl. Here are some examples of these reactions :—

$$\left.\begin{matrix}K\\H\end{matrix}\right\}\Theta + \left.\begin{matrix}NO_2\\H\end{matrix}\right\}\Theta = \left.\begin{matrix}H\\H\end{matrix}\right\}\Theta + \left.\begin{matrix}NO_2\\K\end{matrix}\right\}\Theta$$

Hydrate of potassium. Nitric acid. Nitrate of potassium.

$$\left.\begin{matrix}C_2H_5\\H\end{matrix}\right\}\Theta + \left.\begin{matrix}NO_2\\H\end{matrix}\right\}\Theta = \left.\begin{matrix}H\\H\end{matrix}\right\}\Theta + \left.\begin{matrix}NO_2\\C_2H_5\end{matrix}\right\}\Theta$$

Hydrate of ethyl. Nitric acid. Nitrate of ethyl.

$$\left.\begin{matrix}K\\H\end{matrix}\right\}\Theta + \left.\begin{matrix}H\\Cl\end{matrix}\right\} = \left.\begin{matrix}H\\H\end{matrix}\right\}\Theta + \left.\begin{matrix}K\\Cl\end{matrix}\right\}$$

Hydrate of potassium. Hydrochloric acid. Chloride of potassium.

$$\left.\begin{matrix}C_2H_5\\H\end{matrix}\right\}\Theta + \left.\begin{matrix}H\\Cl\end{matrix}\right\} = \left.\begin{matrix}H\\H\end{matrix}\right\}\Theta + \left.\begin{matrix}C_2H_5\\Cl\end{matrix}\right\}$$

Hydrate of ethyl. Hydrochloric acid. Chloride of ethyl.

The same relations exist between the inorganic and the organic hydrates which contain polyatomic radicals. We may therefore establish the following parallel :—

Monatomic hydrates.	Diatomic hydrates.	Triatomic hydrates.
$\left.\begin{matrix}K'\\H\end{matrix}\right\}\Theta$ Hydrate of potassium.	$\left.\begin{matrix}Mg''\\H_2\end{matrix}\right\}\Theta_2$ Hydrate of magnesium (brucite).	$\left.\begin{matrix}Bi'''\\H_3\end{matrix}\right\}\Theta_3$ Hydrate of bismuth.
$\left.\begin{matrix}(C_2H_5)'\\H\end{matrix}\right\}\Theta$ Hydrate of ethyl.	$\left.\begin{matrix}(C_2H_4)''\\H_2\end{matrix}\right\}\Theta_2$ Hydrate of ethylene (glycol).	$\left.\begin{matrix}(C_3H_5)'''\\H_3\end{matrix}\right\}\Theta_3$ Hydrate of glyceryle (glycerine).

Tetratomic hydrates.	Hexatomic hydrates.
iv. $\left.\begin{matrix}Sn\\H_4\end{matrix}\right\}\Theta_4$ Stannic hydrate.	vi. $\left.\begin{matrix}[Fe_2]\\H_6\end{matrix}\right\}\Theta_6$ Ferric hydrate.
iv. $\left.\begin{matrix}(C_4H_8)\\H_4\end{matrix}\right\}\Theta_4$ Erythrite.	vi. $\left.\begin{matrix}[C_6H_8]\\H_6\end{matrix}\right\}\Theta_6$ Mannite.

Ethers may be compared to salts. This is evident from their mode of formation, as shown by the preceding equations. It is also proved by certain of their reactions. Thus the action of potash upon ethers may be compared to the action of potash upon salts. When ethers composed of alcohol, glycol, or glycerine are treated with potash, the corresponding hydrates are set free, as hydrate of copper is set free when potash acts upon a salt of copper. And further, MM. Friedel and Crafts have recently proved that an alcohol, when heated with an ether of another alcohol, sets free a certain quantity of the latter, as potash sets free hydrate of copper in a solution of the sulphate. I do not think it advisable to insist upon those analogies which are not evident and recognised by all chemists. I merely wish to compare some ethers of glycol to certain salts.

We may form ethers of glycol by combining directly oxide of ethylene with acids. Thus, by the action of acetic acid upon oxide of ethylene, we may easily obtain two ethers, which are formed by virtue of the following reactions :—

$$C_2H_4\Theta + \left.\begin{matrix}C_2H_3\Theta\\H\end{matrix}\right\}\Theta = \left.\begin{matrix}C_2H_4\\C_2H_3\Theta\\H\end{matrix}\right\}\Theta_2$$

Oxide of ethylene. Acetic acid. Monacetic glycol.

$$C_2H_4\Theta + 2\left[\left.\begin{matrix}C_2H_3\Theta\\H\end{matrix}\right\}\Theta\right] = 2\left(\left.\begin{matrix}C_2H_4\\C_2H_3\Theta\end{matrix}\right\}\Theta_2\right) + H_2\Theta.$$

Oxide of ethylene. Acetic acid. Diacetic glycol.

These reactions correspond in all points to those of acetic acid upon oxide of lead or oxide of copper—

$$PbO + \left.\begin{matrix}C_2H_3O\\H\end{matrix}\right\}O = \left.\begin{matrix}Pb\\C_2H_3O\\H\end{matrix}\right\}O_2.$$

Oxide of lead. Acetic acid. Bibasic acetate of lead.

$$PbO + 2\left[\left.\begin{matrix}C_2H_3O\\H\end{matrix}\right\}O\right] = 2\left.\begin{matrix}(C_2H_3O)\\Pb\end{matrix}\right\}O_2 + H_2O$$

Oxide of lead. Acetic acid. Neutral acetate of lead.

Certain basic nitrates have a similar composition—

$$\left.\begin{matrix}P''b\\NO_2\\H\end{matrix}\right\}O_2$$

Basic nitrate of lead of M. Pelouze.

$$\left.\begin{matrix}[Hg_2]''\\NO_2\\H\end{matrix}\right\}O_2$$

Mercurous mononitrate (colourless soluble rhomboidal prisms : Gerhardt).

$$\left.\begin{matrix}Bi'''\\NO_2\\H_2\end{matrix}\right\}O_3$$

Soluble subnitrate of bismuth.

The neutral acetates of lead and of copper correspond to the ethylenic diacetate; the bibasic acetates of lead and of copper correspond to the ethylenic monacetate—

$$\left.\begin{matrix}(C_2H_4)''\\(C_2H_3O)\\H\end{matrix}\right\}O_2, \qquad \left.\begin{matrix}Pb''\\(C_2H_3O)\\H\end{matrix}\right\}O_2 + aq\ddagger \qquad \left.\begin{matrix}Cu''\\(C_2H_3O)\\H\end{matrix}\right\}O_2 + aq.\S$$

Ethyleuic monacetate. Plumbic monacetate. Cupric monacetate.

$$\left.\begin{matrix}(C_2H_4)''\\(C_2H_3O)_2\end{matrix}\right\}O_2, \qquad \left.\begin{matrix}Pb''\\(C_2H_3O)_2\end{matrix}\right\}O_2 + 3aq, \qquad \left.\begin{matrix}Cu''\\(C_2H_3O)_2\end{matrix}\right\}O_2 + aq.$$

Ethylenic diacetate. Plumbic diacetate. Cupric diacetate.

MM. Maxwell Simpson and Lourenço have described some mixed ethylenic ethers which contain 2 radicals of different acids, each of these radicals replacing 1 atom of the hydrogen in hydrate of ethylene (glycol). Thus there exists an ethylenic acetobutyrate, and this ether may be compared to the barium and strontium acetonitrates which have been described by M. C. de Hauer.‖

$$\left.\begin{matrix}(C_2H_4)''\\H_2\end{matrix}\right\}O_2, \qquad \left.\begin{matrix}Sr''\\H_2\end{matrix}\right\}O_2, \qquad \left.\begin{matrix}Ba''\\H_2\end{matrix}\right\}O_2.$$

Ethylenic hydrate. Strontium hydrate. Barium hydrate.

$$\left.\begin{matrix}(C_2H_4)''\\(C_2H_3O)'\\(C_4H_7O)'\end{matrix}\right\}O_2, \qquad \left.\begin{matrix}Sr''\\(C_2H_3O)'\\(NO_2)'\end{matrix}\right\}O \qquad \left.\begin{matrix}Ba''\\(C_2H_3O)'\\(NO_2)'\end{matrix}\right\}O_2.$$

Ethylenic acetobutyrate. Strontium acetonitrate. Barium acetonitrate.

We must here remark that the existence of the strontium and barium acetonitrates supplies an argument in favour of the diatomicity of strontium and barium of the same value as that which Liebig has drawn from the existence of Rochelle salt in favour of the bibasicity of tartaric acid. We know that the composition of tartaric acid was formerly represented by the formula $C_4H_2O_5,HO$, and that it was considered as monobasic. M. Liebig was the first who proposed to double this formula and to consider tartaric acid as containing 2 equivalents of basic water.¶

In cream of tartar, said he, a single equivalent of water is replaced by potash. In Rochelle salt the first is replaced by potash, the second by soda.

$$C_8H_4O_{10}\left\{\begin{matrix}HO\\HO\end{matrix}\right.$$

Tartaric acid.

$$C_8H_4O_{10}\left\{\begin{matrix}KO\\HO\end{matrix}\right.$$

Acid tartrate of potash.

$$C_8H_4O_{10}\left\{\begin{matrix}KO\\NaO\end{matrix}\right.$$

Anhydrous Rochelle salt.

Thus the existence of the acid tartrates and of the bibasic tartrates led M. Liebig to double the molecular weight and the formula of tartaric acid. In the same way the existence of salts of strontium and barium with two acids may cause the atomic weights of strontium and barium to be doubled.

‡ Aq = H_2O, formula in equivalents = $C_4H_3O_3,2PbO+3HO$.

§ Formula in equivalents = $C_4H_3O_3,2CuO+3HO$.

‖ *Journal für praktische Chemie*, vol. lxxv., p. 431.

¶ *Annalen der Chemie und Pharmacie*, vol. xxvi., p. 154.

On Peroxide of Hydrogen and Ozone (Second Part), by M. C. Weltzien.*

(Continued from page 2.)

In the action of peroxide of hydrogen on alkaline hydrates, hydrated peroxides are also formed, but these decompose into water, hydrated protoxides, and oxygen, just as the peroxides of these metals decompose in contact with water—an action in the course of which a little peroxide of hydrogen is inversely produced:—

$$2HK[O + 2H_2]O_2 = 2HKO_2 + 2H_2O,$$

and

$$2HKO_2 = 2HKO + O_2.$$

This action accounts for the instability of peroxide of hydrogen in the presence of alkalies. Its stability in the presence of acids is accounted for by the fact that these neutralise the basic hydrates which may be present, and not, as many chemists believe, on the supposition that the acids form a compound with the peroxide.

Carbonic and boracic acids do not render the peroxide stable, because the alkaline carbonates and borates have an alkaline reaction.

In all the reactions of the peroxide which give rise to an alkaline hydrate—as, for example, in the action of thallium, of the iodide, permanganate, and ferrocyanide of potassium—the decomposition of the peroxide, which is usually attributed to catalytic action, is really the result of the action of the hydrate. Other metallic hydrates and peroxides act in the same way, alternately reducing and oxidising. Thus the action of thallic hydrate on peroxide of hydrogen results partly from a reduction and partly from the action of the thallous hydrate formed on the peroxide.

The action of ferric hydrate on oxygenated water is certainly due to an analogous transformation.

In Fleitmann's process for obtaining oxygen, the solution of chloride of lime acts like peroxide of hydrogen. By the action of peroxide of cobalt protoxide is at first formed, and then there is a new formation of peroxide.

$$CaCl_2[O_2 + 2Co]O_2 = CaCl_2 + 2CoO_2O_2$$
$$CaCl_2[O_2 + 2Co]O_2 = CaCl_2 + 2CoO_2.$$

The action of peroxide of hydrogen on iron and its salts is always accompanied by the formation of ferric compounds—

$$2FeI_2 + 3H_2O_2 = H_6Fe_2O_6 + 2I_2.$$

The most delicate test for peroxide of hydrogen is chromic acid, which gives a blue compound, soluble in ether, and decomposable into oxygen and oxide of chromium. This, according to Barreswil, is perchromic acid, formed according to the equation—

$$2crO_3 + H_2O_2 = cr_2O_7 + H_2O\dagger$$
$$cr_2O_7 = Cr_2O_3 + 2O_2.$$

* Abstract from *Bulletin de la Société Chimique*, &c., May, 1866, p. 322.

† cr = 53 Cr = 106.

Aschoff and Brodie have both studied this reaction the latter expressing the final result by the equation—

$$2CrO_3 + 6H_2O_2 = Cr_2O_3 + 6H_2O + 9O,$$

observing, at the same time, that the reaction probably passes through several stages.

The author, however, thinks it probable that, as expressed above, the blue compound is formed by the addition of one molecule of peroxide of hydrogen to two molecules of chromic acid, so producing perchromic acid, properly so called, and not the anhydride.

$$2CrO_3 + H_2O_2 = H_2Cr_2O_8.$$

TECHNICAL CHEMISTRY.

A Theoretical Study of the Manufacture of Soda by Leblanc's Process, by M. J. Kolb.* (*Second Part.*)

In the former part of this study, which will be found in places indicated below, the author gave an account of the reactions by which crude soda, black ash or ball soda is produced; and showed that it is essentially a mixture of carbonate of soda with varying proportions of lime and sulphide of calcium. He now goes on to show what changes take place when the black ash comes in contact with water in the digestion and lixiviation.

When ball soda is drawn from the furnace, and while cooling in the air, a decided odour of ammonia is evolved. This the author believes to be owing to the oxidation and decomposition by moist air of the cyanide of sodium formed on the surface of the balls. There is always, he states, a small amount of cyanides present in black ash, owing, as the author shows, to the presence of nitrogenised matter in the coal. In contact with air the cyanide decomposes and carbonate of ammonia is formed, which is volatilised by the heat of the ash.

He next passes on to examine what happens when black ash is exposed to the air for a certain time, describing separately the action of oxygen, of carbonic acid, and of moisture. All the experiments to be hereafter detailed were made upon one and the same ash, carefully made for the express purpose, the percentage composition of which, when drawn from the furnace and cooled protected from the air, was as follows:—

NaO,CO_2	47·79
NaO,SO_3	0·92
NaCl	1·85
$NaOSiO_2$	1·52
$NaOAl_2O_3$	1·44
CaS	29·96
CaO	9·68
CaO,CO_2	5·92
Fe_2O_3	1·21
Coal	1·20
Traces of sulphide of sodium, bisulphides and cyanides, loss and matters not estimated	1·51

One hundred grammes of this ash was treated with a litre of water at 15°, and digested for twenty-four hours. The filtered liquid gave—

$NaOCO_2$	38·56
NaO	3·30
NaS	0·25
$NaOSO_3$	0·92

Exposed to air perfectly dry and deprived of carbonic acid for a month, 100 grammes of the ash reduced to powder and then well spread out weighed, at the end of the month, 100·40 grammes. Treated with water as above, the solution gave—

$NaOCO_2$	34·70
NaO	5·70
NaS	0·25

Another sample of 100 grammes exposed for a month to a current of dry air in a stove heated to 100° increased in weight to 100·31, and the solution obtained as above gave—

$NaOCO_2$	34·60
NaO	5·70
NaS	0·30

The same ash heated to redness in the air for four hours increased in weight from 100 grammes to 108·6 grammes, and the analysis, made as before, gave—

$NaOCO_2$	19·00
NaO	5·10
NaS	0·30
$NaOSO_3$	24·30

This action of heated air on black ash has already been observed by Pelouze, who has remarked that the sulphide of calcium is rapidly oxidised to sulphate, especially in the presence of an alkaline carbonate. The treatment with water then causes the following change:—

$$CaOSO_3 + NaOCO_2 = CaOCO_2 + NaOSO_3.$$

The black ash so roasted becomes yellowish, the coal being completely burnt, and the colour being communicated by peroxide of iron.

To ascertain the influence of carbonic acid on the ash, 100 grammes in fine powder were well spread out in an atmosphere of the dry gas, which was frequently renewed. No alteration in weight had taken place at the end of a month, and the analysis showed—

$NaOCO_2$	36·80
NaO	4·45
NaS	0·38

Contrary to the author's expectation, the dry carbonic acid had acted neither on the lime nor the sulphide of calcium, equally dry. Astonished at the result, he then exposed perfectly anhydrous lime to a current of dry carbonic acid, and proved that no absorption or change of weight took place. When, however, but a little moisture is present in the gas and in the lime, absorption takes place rapidly, and the transformation to carbonate is soon complete.

M. Kolb next submitted the same ash to an atmosphere of moist carbonic acid. The absorption was at first energetic, and after some days, whenever the gas was renewed, that removed was found to have sulphuretted hydrogen with it. Under this treatment the 100 grammes of ash in a month became 132 grammes. The solution it gave was of a deep lemon colour; and the results of the analysis were—

$NaOCO_2$	32·50
NaO	0·00
NaS	6·05
NaS_2	4·12

The following changes had taken place:—The moist carbonic acid first of all carbonated the lime (this explains the absence of caustic soda); then its action was transferred to the sulphide of calcium, which it transformed to carbonate of lime, setting free some sulphydric acid: $CaS + HO + CO_2 = CaO,CO_2 + HS$.

Only a part of the sulphydric acid is disengaged; another part unites with sulphide of calcium to form a sulphydrate of the sulphide — $CaS + HS = CaS,HS$.

* Abstract from *Annales de Chimie et de Physique*, June, 1866, p. 135. For abstracts of the former part of the author's memoir see Chem. News, vol. xiii., pp. 140, 162.

The latter in the presence of water becomes bisulphide of sodium.

Lastly, 100 grammes of the same ash were exposed for a month to air at 15°, saturated with moisture, but deprived of carbonic acid. At the end of the month the weight had increased to 157·40 grammes. The analysis gave—

$NaOCO_2$	. 28·70	$NaOSO_3$	. 6·27
NaO	. 6·92	$NaOS_2O_2$	. traces
NaS.	. 0·30		

In this case we observe an oxidation shown by the presence of sulphate of soda. At the ordinary temperature the sulphides of calcium and sodium are both oxidised, but in a different manner. In the case of sulphide of sodium the oxidation is rapid but incomplete; it stops at the formation of hyposulphite, which remains unchanged under ordinary atmospheric conditions. With sulphide of calcium the oxidation is slower. Hyposulphite is also formed, but this is soon converted into sulphate of lime, which exchanges acids with the carbonate of soda in the presence of water.

Such is the cause of the presence of hyposulphites in crude sodas; they could not be formed in the furnace, where, indeed, they would be immediately decomposed. It is not surprising, then, that a well-made ash—that is to say, one not containing sulphide of sodium—should give no trace of hyposulphites even after long exposure to moist air, while 2 or 3 per cent. of hyposulphites may be found in over-roasted ash, which is rich in sulphide of sodium.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, July 5.

Prof. W. A. MILLER, *M.D., F.R.S., President, in the Chair.*

THIS being an extraordinary meeting of the Society, there were no steps taken towards the election of candidates.

The new *Standard Metres* upon glazed porcelain were exhibited and described by Mr. JAMES YATES, M.A., F.R.S. These have been made in accordance with the suggestions offered at a meeting of the Society in December last,* and consisted of plates of white glazed porcelain about forty inches long and five-eighths of an inch in thickness, their surfaces being divided and marked by different processes, and with variously coloured pigments. One metre was true to the $\frac{1}{500}$th part of its length, and was very conspicuously divided throughout with thick black lines. Another scale showed the yard and metre more accurately in immediate proximity, and coloured red and blue respectively; whilst a third scale showed the effect of leaving a clear space between the graduations of the metre and yard. They were all neatly mounted in mahogany frames, and ready for fixing as mural tablets. Their manufacture had been undertaken by Mr. L. P. Casella, of Hatton Garden, who, with regard to the nature of the material, had adopted the recommendation of Professor Frankland, and it was found that when properly baked in the first instance the porcelain suffered no further contraction in the after process of firing the coloured glaze.

Mr. CASELLA gave some further particulars respecting the manufacture of the scales, and

Dr. FRANKLAND suggested that the edges—in fact, all surfaces—of the porcelain plates should be protected by glaze, for he had observed in one of Sir Benjamin Brodie's garden thermometers an instance of the disintegration of glazed porcelain by frost.

Mr. DAVID FORBES, having paid particular attention and made a great number of experiments upon the glazing of porcelain, hesitated to believe that this material would resist the action of frost. He never saw any description of glazed ware which withstood exposure to a Norwegian climate; the best samples were those of thin substance in which the glaze applied to both surfaces almost met in the centre. The speaker advocated the use of a perfectly vitrified, instead of a semi-vitrified, material, and recommended opal-coated glass, which could hardly be distinguished from white porcelain.

After further observations from Sir Benjamin Brodie, Dr. Frankland, Mr. Brayley, and others, Mr. YATES, and with him Lord WROTTESLEY, as President of the Weights and Measures Committee of the British Association, acknowledged the aid rendered by the Chemical Society in offering suggestions as to the material best suited to the manufacture of their new metrical standards.

Professor A. W. WILLIAMSON then gave a brief discourse "*On the Constitution and Representation of Organic Compounds*," in which he described a new mode of exhibiting rational formulæ by the help of dots or points to indicate the value of the atomicities. The author reviewed the systems of notation in common use, particularly alluding to the string of beads (or "sausages," as they have been humorously termed) of Kekulé; to the system of rakes—thus, |_|_|_|; to the use of brackets, including the substances combined with the carbon written in a column: and, lastly, to the spheres with arms, or poles, introduced by Dr. Crum Brown. The author claimed for his new system the advantages of greater simplicity, and the power of representing a compound by a specific picture, without at the same time hazarding any hypothesis as to the mode of arrangement of the atoms in a molecule. It was, however, like all other pictorial systems, open to the objection that the atoms must be represented in a statical condition, and always shown on the same plane. It must be granted likewise that the use of the dot for another purpose by Berzelius, and lately by Dr. Debus, is not an insuperable difficulty. Professor Williamson then gave a clear exposition of his proposal, and wrote a great number of examples showing the application of his formulæ upon the black board. Amongst them were the following:—

Hydrogen	H . H
Oxygen	O : O
Nitrogen	N ⋮ N
Carbon	C ⋮ C
Phosphorus	P : P P : P
Acetylene	H . C ⋮ C . H
Olefiant gas	H^2 : C : C : H^2
Ethylic hydride	H^3 ⋮ C . C ⋮ H^3
Ferric chloride	Cl^3 ⋮ fe . fe ⋮ Cl^3.

The speaker then referred to a number of examples which required for their representation more than one line, and it was immaterial whether the outstanding constituent was shown above or below, thus—

Propylic hydride	H^3 ⋮ C . $\dot{C}$. C ⋮ H^3
Ferric oxide	H^2 O : fe . fe : O O
Alcohol	H^2 H^3 ⋮ C . $\dot{C}$. O . H
Acetic acid	O H^3 ⋮ C . $\dot{C}$. O . H

* *Vide* CHEMICAL NEWS, vol. xii., p. 305.

Glycollic acid $H^3\ O$ / $H . O . \ddot{C} . \ddot{C} . O . H$

Oxalic acid $O\ O$ / $H . O . \ddot{C} . \ddot{C} . O . H$

The formulæ of several isomeric bodies of the three-carbon series were then represented, particularly those of acetone, aldehyde, allylic alcohol, and methyl-ethyl ether; and the Lecturer proceeded to show the manner in which replacements could be effected, taking for illustration benzol, and producing from it kreosote, pyrogallic acid, and toluol. With regard to the sign of atomicity or equivalence in these formulæ, Dr. Williamson first endeavoured to use lines instead of points, but he considered them objectionable, inasmuch as they were likely to be mistaken for the signs of equality and minus.

The President considered some of the formulæ to be unnecessarily protracted, and made inquiry respecting the modes of abbreviation. In his opinion the new formulæ did assert the constitution as well as the composition of a molecule.

Dr. Frankland explained the system (of brackets) which he was in the habit of using, and showed the abbreviations of which it was capable; thus he would not hesitate to write $CMeH_2$, $CMe''H_2$, &c., and the water-residue hydroxyl thus, Ho. There were defects in the graphic formulæ both of Kekulé and Crum Brown, and in Dr. Williamson's symbol notation there was the liability of mistaking points (often ill-formed in manuscript) for figures.

Dr. Debus cleared himself from the imputation of having employed dots in his formulæ in two different senses; their position on or above the line was sufficiently indicated, thus—

Alcohol $CH_3 . CH_2\dot{H}$.

Sir Benjamin Brodie wished for a clearer explanation of the meaning of the point, and to know by what process of reasoning the author had arrived at a knowledge of the internal constitution of his molecules. The growth of a formula in any simple case ought to have been shown.

Dr. Odling contrasted the various systems of notation used by the previous speakers, and objected to the principle of employing an old symbol under a new signification.

Dr. Williamson replied to the several objections, and, in answer to Sir B. Brodie, quoted the successive removal of hydrogen atoms from the marsh-gas molecule. Abbreviations were allowable, and he would often contract one half of the formula and leave it intact, whilst the other half was undergoing change. The same substance might therefore be differently expressed according to the nature of the reaction about to be defined.

At this stage of the proceedings the President vacated the chair, which was then filled by Sir Benjamin Brodie.

Mr. W. Thorp then read a paper "*On the Reduction of the Oxides of Nitrogen by Metallic Copper in Organic Analysis.*" The experiments made by the author were directed to the removal of sources of error in the determination of nitrogen by volume, as in Dumas' method, and were conducted with the superior means of heating afforded by Hofmann's gas-combustion furnace. Copper wire was flattened to a ribbon of about 3·5 mm. in width, and made into spirals fitting one within another. A length of about 200 mm. was then oxidised, and subsequently reduced in the usual manner, and through the tube containing the copper was passed first carbonic acid and afterwards the mixture of this gas with nitric oxide to be experimented upon. If the flow of gas be moderated to 2 c.c. per minute and the heat maintained at bright redness, nothing but nitrogen was collected in the gas receiver filled with potash and standing over mercury. Other results were obtained at lower temperatures, when it was found that 4, 5, and even 10 per cent. of the nitric oxide escaped decomposition. Aqueous vapour adds somewhat to the difficulties of the method, but the author concludes that it is only necessary to maintain the heat at bright redness and to pass the gas slowly to ensure the evolution of the whole of the nitrogen in the elementary form.

Dr. Frankland referred to the practical difficulties encountered in former attempts to decompose the whole of the nitric oxide when the charcoal furnace was used.

The Secretary then read a "*Note on the Hydrocarbons contained in Crude Benzol,*" by Mr. C. Schorlemmer. By acting with bromine upon crude benzol, boiling between 80°—82° C., digesting with sodium and fractionating, the author obtained a mixture of hydrocarbons which by a second treatment with bromine furnished amongst other products the compound $C_6H_{10}Br_2$. By adding an excess of bromine to this liquid, long, white, needle-shaped crystals gradually separated out, which after washing with alcohol proved to have the composition $C_6H_{10}Br_4$. These crystals melt at 112° C., and distil without decomposition at 318° C. From these results the author infers that crude benzol contains, besides members of the oleline series, the hydrocarbon C_6H_{10}, which may be identical with the "hexoylene" of M. Caventou, which boils at 80°—85° C. For the preparation of a very pure sample of benzol Mr. Schorlemmer recommends that the crude mixture of hydrocarbons should be treated with bromine, and subsequently with potash, before rectification. Such a product furnishes a nearly colourless nitrobenzol, and dissolves in concentrated sulphuric acid almost without coloration.

Another communication, entitled "*Note on Ethyl-Hexyl Ether,*" by the same author, was read by the Secretary. When acting upon chloride of hexyl with alcoholic potash, Cahours and Pelouze discovered that the hexylene—the main product of the reaction—was mixed with other substances. One of these latter has been identified by Mr. Schorlemmer, and proved to have the composition $C_8H_{18}O$. This body is assumed to be the ethyl-hexyl ether, and may be viewed thus—

$$\left.\begin{matrix} C_2H_5 \\ C_6H_{13} \end{matrix}\right\} O.$$

A vote of thanks was passed to the respective authors, and at a late hour the meeting was adjourned until November.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, May 4, 1866.

Sir Henry Holland, *Bart., M.D., D.C.L., F.R.S., President, in the Chair.*

On Recent Progress in the History of proposed Substitutes for Gunpowder, by Professor F. A. Abel, *F.R.S., V.P.C.S., Chemist to the War Department.*

(*Continued from page 6.*)

The conversion of purified lignin or wood fibre into an explosive substance of the same nature as gun-cotton, was accomplished by chemists soon after Schönbein's discovery of gun-cotton was made known. Finely divided wood, or sawdust, may, by treatment with suitable agents, be to a very considerable extent purified of substances foreign to cellulose; and if then submitted to careful digestion in a mixture of the strongest nitric and sulphuric acids, and properly purified, it furnishes a highly explosive material similar to the most explosive gun-cotton, and possessed apparently of considerable stability. Captain Schultze, a Prussian artillery officer, who was entrusted by his government a few years ago with the investigation of gun-cotton, appears to have come to the conclusion that finely-divided wood offered greater prospect of conversion into a controllable explosive agent than cotton wool. The ultimate result of his investigations has been the production of a "gun-sawdust," the explosive properties of

which depend in great measure upon its impregnation with a considerable proportion of an oxidising agent, either saltpetre or a mixture of that salt and nitrate of barium. The wood, having been reduced to a tolerably uniform state of division, is submitted by Captain Schultze to purifying processes for the separation of resinous and other substances from the lignin, and the product is converted by digestion in a mixture of sulphuric and nitric acids into a very feebly explosive material, which leaves a considerable carbonaceous residue when burnt. This product after purification is impregnated with a sufficient proportion of nitrates to give it rapidly explosive power, the oxidation of the carbon being now almost complete. The objects which appear to be aimed at by Captain Schultze in following this method of manufacturing a wood-gunpowder, are, the production of a more gradually explosive material than is obtained by the most perfect action of nitric acid upon wood-fibre, and the possibility of preserving the material in a slightly explosive and therefore comparatively harmless form until it is required for use, when it may be soon rendered powerfully explosive by impregnation with the nitrates. It is asserted that this powder is considerably more powerful than gunpowder as a mining agent; and that, by its employment in mines, the operators are enabled to return to work sooner than when gunpowder is used, because there is little or no smoke produced by its explosion. The latter is an undoubted advantage which Schultze's powder shares with gun-cotton. Advantages are also claimed for this material when employed in firearms, and it is possible that, when applied to sporting purposes, it may compete successfully with gunpowder in this direction also; but its behaviour as an explosive, and the peculiarities of its structure, afford little promise of its advantageous employment in arms for military and naval purposes.

Important progress has been made in the history and the practical application of gun-cotton since its study was resumed in this country about three years ago. Very considerable quantities of the material have been manufactured at the works of Messrs. Prentice at Stowmarket, and at the Government Gunpowder Works at Waltham Abbey; its application to mining and artillery purposes, and to small arms, has been, and is still, the subject of systematic experiment, conducted by the Government Committee on Gun-cotton; its employment as a blasting agent is steadily increasing in several important English mining districts; and considerable, though not uniform, success has already attended the employment of gun-cotton cartridges for sporting purposes.

The system of manufacture of gun-cotton, as perfected by Baron Von Lenk, has undergone but trifling modifications in its employment in this country. It has been made the subject of careful investigation by Mr. Abel, and the results furnished by many experimental manufacturing operations and an examination of the products have shown that the process of converting cotton into the most explosive form of pyroxilin or gun-cotton, and of purifying the material, have been so greatly perfected by Von Lenk as to render a strict adherence to his simple and precise instructions alone necessary to ensure the preparation of very uniform products, which exhibit in their composition a very much closer approximation to purity than those obtained in the earlier days of the history of gun-cotton.

Although the conclusions arrived at by the many chemists who investigated the composition of gun-cotton, soon after Schönbein's discovery, varied very considerably, the constitution has been very generally regarded as definitely established by the researches of Hadow, published in 1854. According to that chemist, the most explosive gun-cotton has the composition expressed by the formula $C_6H_7N_3O_{11}$ (which was first assigned to the substance by W. Crum, in 1847), and may be regarded as cellulose, in which three atoms of hydrogen are replaced by three molecules of peroxide of nitrogen. The name *trinitro-cellulose* has therefore been assigned to gun-cotton, its constitution being expressed by the formula—

$$C_6 \left\{ \begin{matrix} H_7 \\ 3NO_2 \end{matrix} \right\} O_5.$$

Hadow's conclusions have since been confirmed by other chemists, more especially by Redtenbacher, Schrötter, and Schneider, who have analysed specimens of gun-cotton prepared under Von Lenk's directions. But a report upon the Austrian gun-cotton was published in 1864 by Pelouze and Maury, in which the formula $C_{24}H_{36}O_{18},5N_2O_5$ is assigned to the product of Von Lenk's process; the conclusions of those chemists being founded partly upon some analytical results, and partly upon the increase of weight which they found cotton to sustain when submitted to treatment with the mixed acids. They found the greatest increase in weight to be 78 per cent.—a number slightly in excess of that which would correspond to the requirements of the formula which they adopt.

An experimental inquiry into the composition of gun-cotton, as obtained by Von Lenk's process, has been instituted by Mr. Abel; and the very numerous analytical and synthetical results which he has obtained confirm the correctness of the formula assigned by Crum and Hadow to the most explosive gun-cotton, and demonstrate satisfactorily that the products obtained by following strictly the instructions given by Von Lenk are invariably trinitrocellulose, in a condition as nearly approaching purity as a manufacturing operation can be expected to furnish.

The most explosive gun-cotton is perfectly insoluble in mixtures of ether and alcohol; but by varying the proportions and strength of the acids employed for the conversion of cotton, products of less explosive character are obtained, which are more or less freely soluble in ether and alcohol (furnishing the well-known material collodion). If, therefore, in manufacturing gun-cotton, the conditions essential to the production of insoluble pyroxilin are not strictly fulfilled, the uniformity of the product will suffer.

The ordinary products of manufacture are never altogether free from soluble gun-cotton; but the proportion present is small and very uniform, amounting to about 1·5 per cent. They contain, besides, a small quantity (about 0·5 per cent.) of matter soluble in alcohol alone, and possessed of acid characters, which is evidently produced by the action of nitric acid upon such small quantities of resinous or other matters foreign to pure cellulose as are not completely removed from the cotton fibre by the purification which it receives.

There appears good reason to believe that this impurity in gun-cotton is of comparatively unstable character, and that the great proneness to spontaneous decomposition which has been observed by Pelouze and Maury, De Luca, and others, in some specimens of gun-cotton, is to be ascribed in great measure to the existence in those specimens of comparatively large proportions of those unstable by-products.

One hundred parts of carefully-purified cotton wool have been found by Mr. Abel to furnish from 181·8 to 182·5 parts of gun-cotton. The increase which perfectly pure cellulose should sustain by absolutely complete conversion into a substance of the formula $C_6H_7N_3O_{11}$ (trinitro-cellulose) is 83·3; the above results are therefore strong confirmations of the correctness of this generally-accepted view of the composition of gun-cotton. In carrying out the actual manufacturing process as prescribed by Von Lenk, somewhat lower results are obtained, because of impurities existing in the cotton employed, and of loss of product during its purification.

Very extensive experiments are in progress at Woolwich, with the view of examining fully into the extent of liability to change of gun-cotton when preserved in store, or exposed for prolonged periods to light and to degrees of heat ranging between the ordinary atmospheric temperatures and that of boiling water. The results hitherto arrived at, though they have shown that, under

severe conditions, gun-cotton is liable to decompose, have not confirmed the conclusions arrived at by the French chemists with regard to the great instability of the material. Thus De Luca states that all specimens exposed by him to sunlight decomposed either on the first day or within a few days. But at Woolwich no single instance of such rapid decomposition of gun-cotton, made by the present process, has been noticed. A very gradual and slight development of gas occurs after a time when the substance is exposed to sunlight; but the quantity which has been collected from specimens exposed at Woolwich to direct day- and sun-light for two years and a half is very small, and the gun-cotton has in all instances preserved its original appearance. Pelouze and Maury state that gun-cotton always decomposes perfectly within a few days, by exposure to temperatures of 55°—60° C. (130°—140° F.), and they lay great stress upon the explosion of a specimen directly it was introduced into a vessel heated to 47° C. (116·6° F.). But at Woolwich a specimen of ordinary product which has been exposed now for twelve months to 65° C. (150° F.) has evolved only a small quantity of gas, and retains its original appearance perfectly. Several specimens, after having been exposed for some hours to a temperature of 90° C. (194° F.), during which period some nitrous vapours were in all instances evolved, have since been exposed to light in closed vessels for about twenty months, and still retain their original appearance and explosive characters. Several large ammunition cases, closely packed with gun-cotton, have been preserved for six months in a chamber, the temperature of which was maintained for three months at 49° C. (120° F.), and afterwards at 54°—55° C. (130° F.), arrangements having been made for periodically registering the temperature within the boxes, which were kept closed. In no instance has the latter temperature risen to an extent to indicate serious chemical change, *i.e.*, it has always been below the temperature of the air in the chamber. These few examples of results already obtained are given to show that the behaviour of gun-cotton manufactured in England by Von Lenk's process does not, as yet, at all justify the condemnation which the material has recently received in France.

One most important point in connection with the preservation of gun-cotton appears to have been lost sight of by the French experimenters. The material may be most perfectly preserved, apparently for any period, either by immersion in water, or, still more simply, by being impregnated with just sufficient moisture to render it perfectly uninflammable. In this condition gun-cotton is much safer than gunpowder can be rendered, even by mixture with very large proportions of incombustible materials. It may be transported with quite as much safety as the unconverted cotton; indeed, it appears to be very much less prone to gradual decay, if preserved for very long periods in a damp condition, than cotton or other vegetable substances. Many specimens of gun-cotton, preserved for several months in a very damp chamber, together with paper, cotton fabrics, and wood, retained their strength of fibre and all their original properties, and had no signs even of mildew upon them, while the paper fabrics in immediate contact with them had completely rotted away, and the wood was covered with fungi.

Considerable progress has been made in the manipulation of gun-cotton, with the object of modifying its explosive action. The rapidity with which gun-cotton burns in open air admits of ready and very considerable variation by applying the simple expedients of winding, twisting, or plaiting gun-cotton yarn of different sizes. But although a mass of gun-cotton may be made to burn in a comparatively gradual manner by being very tightly wound, a charge of the material in that form acts quite as destructively when exploded in the bore of a gun as an equal charge consisting of the yarn wound very loosely, because the pressure of gas established by the first ignition of the charge renders the compact packing of the gun-cotton powerless to resist the instantaneous penetration of flame between the separate layers of the material. The assertion that a power had been acquired of controlling the explosive action of gun-cotton in a firearm by simply varying the compactness with which the material was twisted or wound, has therefore proved quite erroneous. There are, however, two methods of reducing the rapidity of explosion of gun-cotton, which are much more likely to furnish successful results. The one consists in diluting the material by its admixture either with a less explosive variety of gun-cotton or with some inexplosive substance, such, for instance, as the cotton in its original form. The latter mode of dilution has recently been applied by Messrs. Prentice to the construction of cartridges for sporting purposes, and they describe the results already arrived at as very promising. The second method of controlling the explosion of gun-cotton consists in consolidating the material by pressure into compact homogeneous masses, and in confining the first ignition of such compressed gun-cotton in the bore of the gun to certain surfaces. The gun-cotton fibre in the form of yarn or plait may be compressed into very compact masses by being rammed into strong cylinders of pasteboard or other suitable material; but much more perfectly homogeneous and solid masses are produced, independently of cylinders or other cases, by a method which Mr. Abel has recently elaborated, and which consists in reducing the gun-cotton fibre to a fine state of division or pulp, as in the process of paper-making, and in converting this pulp by pressure into solid masses of any suitable form or density.

This method of operating affords also special facilities for combining both methods, dilution and compression, of reducing the explosive violence of gun-cotton. The material is, in fact, operated upon by this system, in a manner exactly corresponding to the processes by which the explosive action of gunpowder is regulated to so remarkable an extent. Some results, which are admitted by the most sceptical as encouraging, have already been arrived at in the systematic course of experiments which are in progress with the object of applying the methods of regulation pointed out to the reduction of gun-cotton to a safe form for artillery purposes. Its arrangement in a form suitable for small arms is a much less difficult problem, which may be considered as approaching a perfect solution. For employment in shells and for military mines, both land and submarine, the compressed or solid form of gun-cotton presents special advantages, on account of the great compactness which may be imparted to it; a given weight arranged so as to ignite instantaneously under pressure (*i. e.*, in strong vessels), may be made to occupy the same space as an equal weight of gunpowder, whereas the forms of gun-cotton hitherto applied to these purposes occupy about three times the space of gunpowder.

Beautiful pyrotechnic effects may be readily produced by means of gun-cotton, though the absence of smoke, which, in some of its applications (especially in mines), would constitute an important advantage, detracts from some of the effects which may be obtained with pyrotechnic compositions. On the other hand, gun-cotton fireworks may be displayed indoors without inconvenience.

There appears at present no reason to doubt that the application of gun-cotton with great advantage to at least some of the more important purposes for which gunpowder is used, will ere long be fully established, and that this interesting explosive agent is destined to occupy a permanent and prominent position among the most important products of chemical industry.

ACADEMY OF SCIENCES.—*July 2.*

M. Becquerel presented a memoir "*On the Formation of Various Compounds, and particularly Silicates, by Slow Reactions.*" The extract from this memoir published

gives us but little information of interest or novelty. The general method by which he forms silicates is by saturating a porous body with one solution, which will react slowly on another solution in which the porous body is placed. Thus he saturated a lump of chalk with a solution of nitrate of copper, and then immersed it in a solution of silicate of potash. The result, in course of time, was the formation of silicate of lime, and carbonate and nitrate of potash. By using in a similar way aluminate of potash, the author obtained prismatic crystals of aluminate of lime. A double silicate of lime and potash was obtained by causing a solution of silicate of potash to run for a lengthened period over a plate of gypsum. Part of the memoir is devoted to a notice of some reductions which take place under the influence of electricity. This offers nothing of interest. The following method of producing basic chromate of lead is new to us. The yellow chromate is made into a paste with water, spread on a plate of zinc, and covered with a glass plate. The zinc reacts on the chromate, removing one equivalent of chromic acid and leaving the vermilion-coloured basic chromate.

M. Aug. Cahours presented a note "*On Vapour Densities.*" Where is the necessity, the author asks, for believing that the molecules of all bodies must give absolutely four volumes of vapour? Why may not one vapour correspond to eight volumes, while another is represented by four volumes? Must we really admit the fact of dissociation in all cases of eight volumes? M. Cahours, whose labours on this subject have extended over many years, believes that a volatile compound in a state of vapour only exists in one grouping representing four or eight volumes; it might, he thinks, represent two or six volumes, but this mode of grouping is still unknown to us. He does not believe in three or six volumes. M. H. St. Claire Deville made some remarks after M. Cahours. He believes that the vapour volume may vary with the temperature, and appears to think it too early yet to dogmatise on the subject. We may perhaps take another opportunity of presenting the reasoning of both these gentlemen more fully.

M. Nicklés presented a second note "*On New Solvents of Gold,*" in which he showed that iodine under pressure, or even under the influence of light, will dissolve gold-leaf. The sesqui-iodide and sesqui-bromide of iron also act as solvents.

M. de Charcourtois communicated a note "*On the Natural and Artificial Production of the Diamond.*" The author believes that the diamond is formed in consequence of the decomposition of hydrocarbons, just as free sulphur results from the decomposition of hydro-sulphuretted emanations. The hydrogen in these cases combines with oxygen, leaving the other element free. Many methods of producing diamonds have been thought of, but no one has yet thought of imitating the process followed by Nature, which the author suggests may be done as follows:—Submit a very slow current of marsh-gas or a hydrocarbon vapour accompanied by the vapour of water to a very mild oxidising action in a mass of sand containing traces of putrescible matter—flour, for example. The author is not slow to point out that this very process has been going on under our noses for a good many years past, and he suggests that diamonds, or at least diamond-dust, may be found in the black earth that surrounds the gas-pipes where they leak under our streets.

Dr. Frankland was elected a corresponding member of the Academy by twenty-nine out of thirty-five votes.

Bismuth Test for Glucose.—MM. Francqui and Vyvere prepare the test as follows:—Nitrate of bismuth is first precipitated by a considerable excess of potash; the mixture is then moderately heated, and tartaric acid added until the precipitate is dissolved, when the re-agent is ready. A few drops of this test boiled with diabetic urine gives a black deposit of metallic bismuth.

NOTICES OF BOOKS.

Journal de Pharmacie et de Chimie. June, 1866.

The above-named journal contains two or three articles which we have not had the opportunity of noticing before. One is entitled "*Chemical Researches on the Brain,*" by M. A. E. Bourgoin, which gives the results of well-executed experiments performed under the direction of M. Berthelot. Perhaps the most important result the author has arrived at is the fact that *cerebrine*, or cerebric acid, does not contain phosphorus. In what combination this element does exist in cerebral matter the author does not explain. He tells us, however, that it is found in much larger quantity in the grey matter than in the white; that the amount found in the brain may vary within rather extensive limits, but that the average proportion present amounts to 2 per cent. of the dried cerebral matter. The amount of water present is about 73·5 per cent. of the white substance and 83 per cent. of the grey. The author seems to doubt whether there is any relation between the amount of the phosphorus present in a brain and the intelligence of the individual it belonged to. He seems to think that phosphorus may become concentrated, so to say, in a brain, for that one in which he found the largest quantity belonged to an individual who died of phthisis, and it might be that the properly called fatty matters exempt from phosphorus may be absorbed at a greater rate than the principles which contain the phosphorus. The amount of nitrogen in a brain also appears to vary considerably; the grey matter contains most, but the average amount in the dried grey and white substances taken together appears to be about 7 per cent. The general examination appears to indicate the presence of several albuminoid principles which require a fuller examination.

The next paper we may notice, and which we shall shortly give in detail, relates to the "*Employment of Magnesium in Toxicological Examinations.*" The paper by M. Roussin, read before the Pharmaceutical Society of Paris, shows that this metal may advantageously replace zinc in toxicological examinations for metals. Magnesium has the double advantage of rapidly and completely precipitating poisonous metals without the danger of introducing any other poisonous substance. Arsenic and antimony are not precipitated, but will be found of course in the gas disengaged and the liquid remaining. The author destroys organic matter by the usual methods, concentrates the acid liquor, and then introduces plates of magnesium as long as any deposit is formed. This precipitate is washed and examined by the usual method for metals. If the operation be conducted in a Marsh's apparatus, the gases may at the same time be examined for arsenic and antimony.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

1207. A. V. Newton, Chancery Lane, "Improvements in the manufacture of steel."—A communication from E. L. Bonreisler, Philadelphia, Penn., U.S.A.—Petition recorded April 28, 1866.

1256. P. Spence, Manchester, "Improvements in the separation of certain metals from their ores, and in the production of sulphide of ammonium to be used in the process, which sulphide is also applicable to other purposes for which that salt is required."—May 3, 1866.

1537. A. Paraf, Manchester, "Improvements in dyeing, printing, and other operations based on chemical reactions."—A communication from M. Paraf, Tuval, Thaan, France.—June 2, 1866.

1564. A. Parkes, Birmingham, "Improvements in the manufacture of compounds in the nature of kamptulicon." —June 6, 1866.

1232. J. Thomas, Battersea, Surrey, and A. Prince, Trafalgar Square, Charing Cross, Middlesex, "Improvements in reverberatory blast and other furnaces for smelting ores, and in the means of extracting the precious metals therefrom."—Petition recorded May 1, 1866.

1594. T. J. Leigh, Lansdowne Cottages, Denmark Street, Camberwell, Surrey, "Improvements in the method of burning coals (whether large or small coals), coal dust, coke, coke dust, charcoal, wood, and other combustible substances, as also hydrocarbons and gases, and in the arrangement of the furnaces applicable thereto."—June 12, 1866.

1615. G. D. Malam, Halifax, Yorkshire, "The purifying of ammoniacal liquor by an improved process, and the application of such purified ammoniacal liquor to the purifying of coal gas."

1623. W. Knaggs, Euston Grove, Euston Square, Middlesex, "Improvements in the manufacture of sugar, and in the apparatus employed therein."

1625. V. Gallet, Lavausseau de Benassais, Vienne, France, "Improvements in the manufacture of cast steel." —June 14, 1866.

1626. L. A. de Milly, Rue de Calais, Paris, "A new process in the treatment of concrete fatty acids for the manufacture of candles called 'stearine candles.'"

1628. B. F. Stevens, Henrietta Street, Covent Garden, Middlesex, "A new or improved method of treating permanent inflammable gases, whereby greater heat is obtained therefrom."—A communication from S. Stevens, New York, U.S.A.—June 15, 1866.

1637. G. L. Léclanché, Rue Gaillon, Paris, "Improvements in voltaic piles."—June 16, 1865.

1639. J. E. T. Woods, Camberwell Grove, Surrey, "Improvements in the manufacture of pigments."

1640. W. B. Patrick, Mincing Lane, London, "Improvements in the treatment of animal charcoal used by sugar refiners or others, in order to its re-use."—June 18, 1866.

1642. A. Paraf, Manchester, "Improvements in fixing colouring matters on textile fabrics, yarns, or other materials."—June 19, 1866.

1654 D. A. Fyffe, Glammis, Forfarshire, N.B., "Improvements in the manufacture of pulp."

1657. J. Möller, Shaftesbury Villas, Hornsey Rise, Middlesex, "Improvements in obtaining and preparing colouring matter for printing, dyeing, and other purposes." —June 20, 1866.

1697. J. Young, jun., Limefield, Midlothian, N.B., "Improvements in apparatus for the treatment of hydrocarbon oils."

1703. W. R. Lake, Southampton Buildings, Chancery Lane, "Improvements in the manufacture of white lead." —A communication from W. Bell, T. M. Fell, and A. G. Fell, New York, U.S.A.—June 26, 1866.

1707. H. Medlock, Tavistock Square, Middlesex, and W. Bailey, Wolverhampton, "Improvements in preserving animal substances."

1710. W. R. Lake, Southampton Buildings, Chancery Lane, "Improvements in the mode of distilling or separating volatile products from oils and other fluids."—A communication from H. L. Smith, Gambier, Ohio, U.S.A. —June 27, 1866.

Notices to Proceed.

513. J. Kidd, Battersea Rise, Surrey, "Improvements in carburetting low pressure superheated steam, air, or coal gas for lighting and heating purposes, for generating steam or hydrocarbon vapour, and in apparatus employed therein."—Petition recorded February 17, 1866.

545. J. D. Brunton, Leighton Crescent, Kentish Town, Middlesex, "Improvements in the manufacture of peat fuel, and in the machinery employed therein."

550. C. de Cæsaria, Bermondsey, "Improvements in preparing hides and skins for tanning." February 22, 1866.

565. R. Milburn, jun., Tulse Hill, Brixton, and W. H. Baxter, Elm Cottage, Brixton Hill, Surrey, "Improvements in the treatment of brewers' and distillers' grains." —February 23, 1866.

606. W. E. Newton, Chancery Lane, "An improved process of, and apparatus for, distilling petroleum and other liquid substances."—A communication from J. P. Vincent, J. S. Richards, O. Noble, C. H. Lovelin, and H. Rawle, Erie, Pennsylvania; and L. S. Fales, New York, U.S.A.—February 28, 1866.

921. J. Davis, Sussex Road, Southsea, Hants, "An improved method of preventing the putrefactive decomposition of vegetable and animal substances, and utilising the same for agricultural purposes."

922. J. Davis, Sussex Road, Southsea, Hants, "Improvements in obtaining caustic alkalies to be used as disinfectants and decarbonisers, and the means by which the same are to be applied, as also for applying the gases liberated in the process to the conversion of iron into steel, and for the manufacture of manures."—March 31, 1866.

1649. G. T. Bousfield, Loughborough Park, Brixton, Surrey, "An improved process of utilising waste vulcanised india-rubber, and manufacturing hard rubber therefrom." —A communication from C. McBurney, Roxbury, Norfolk, Mass., U.S.A.—June 19, 1866.

CORRESPONDENCE.

Amount of Sulphuric Acid obtainable from Pyrites.

To the Editor of the Chemical News.

Sir,—I beg to give the following results in answer to the inquiry of "W. L. R." in your last number:—1 ton of Irish pyrites at 30 per cent. sulphur should make theoretically 1 ton 1 cwt. 3 qrs. $23\frac{4}{8}\frac{3}{2}\frac{3}{5}$ lbs. of acid at 1750 strength.

On account of a slight loss of gas being almost inevitable while in chambers and a small percentage of sulphur being left in burnt residue, I find the practicable quantity one is able to obtain from 1 ton of pyrites is as follows:—18 cwts. 1 qr. 5 lbs. to 18 cwt. 2 qrs. Hoping this may be satisfactory to "W. L. R.," I am, &c.

A Practical Chemist.

July 9, 1866.

MISCELLANEOUS.

Chemical Society.—We have been requested to insert the following addendum to our report of the meeting of the Chemical Society on the 21st ult.:—

Mr. Newlands inquired whether Dr. Debus considered it possible, in accordance with the views which he had just brought before the Society, for two hydrocarbons to exist having the formula C_2H_3, alluding, of course, to the disputed identity of methyl and hydride of ethyl. Also, after mentioning the fact that the two atoms of carbon might in ethylic hydride be considered as united by one affinity, in olefiant gas by two affinities, in acetylene by three affinities, and, lastly, in the molecule of free carbon by four affinities, Mr. Newlands inquired whether Dr. Debus considered it necessary to admit the existence of bivalent carbon in carbonic oxide.

Dr. Debus replied that, according to the present state of his information on the subject, it was only possible for one hydrocarbon to exist having the formula C_2H_3. He also stated that he thought it was necessary to admit the existence of biatomic carbon in carbonic oxide.

Mr. Newlands then proposed to represent the anomalous constitution of carbonic oxide by adopting for it a doubled formula; but

Dr. WILLIAMSON reminded him that the density of the compound in question would not accord with this otherwise very convenient proposal.

Death from an Experiment.—Mr. Toynbee, the well-known aurist, was found dead in his consulting-room last Saturday afternoon. There can be no doubt that the unfortunate gentleman killed himself accidentally by inhaling the mixed vapours of chloroform and prussic acid. The evidence of Dr. Markham, at the inquest, details the circumstances under which the deceased was found. He said:—"I found the deceased on the sofa perfectly dead. There was some cotton wool on the table close by, and witness's attention was attracted by a smell of chloroform in the room. The cotton wool smelt strongly of chloroform. Dr. Leared happened to come in at that time, and they both tried artificial respiration for half an hour without the least hope of restoring life. There was not the slightest sign.—By the Coroner: There were papers on two chairs, and a watch upon one set of the papers. On the first set there was a slip which referred to an experiment apparently tried on Thursday last—viz., 'The effect of inhalation of the vapour of chloroform for singing in the ears, so as to be forced to the tympanum, either by being taken in by the breath through a towel or a sponge, producing a beneficial sensation of warmth.' The second paper was an experiment on 'The effect of chloroform combined with hydrocyanic acid.' This was not clipped, apparently waiting for a result. Close to his hand, on the chair, were two bottles which had been obtained at Bell's that afternoon. The one contained rectified ether, which had not been opened. The second was a little more than half full of hydrocyanic acid. He did not detect any smell of hydrocyanic acid, for that acid would evaporate very quickly. There was also a machine made of india-rubber lying on the chair used for injecting ether or other vapours, and afterwards was found, underneath the sofa, just as his hand—that of a dead man's—would fall, a six-ounce bottle, completely empty, which had contained chloroform, but was dry and free from smell. The stopper was not in. From his experience he should say the appearances were quite consistent with death from the effects of chloroform, but it was not possible to say that there was a combination of hydrocyanic acid with the chloroform, owing to the advanced state of decomposition of the body, both being so volatile that they speedily evaporated in an ordinary temperature. In answer to further inquiries, he said he had made a post-mortem examination, but not an analysis, as he did not consider it necessary. In fact, there were no contents in the stomach to analyse, and not the remotest smell of the acid, which must have been present had it been taken in quantity into the system. He believed that the death was due to chloroform, but what effect the prussic acid would produce in combination with the chloroform in vapour he could not tell. Witness here produced a letter written by deceased to Dr. Gibson on the 6th inst., in which was expressed an opinion that Clover's apparatus for inhaling the vapour of hydrocyanic acid could be safely applied to the tympanum. This was explained by stating that the vapour was inhaled to the back of the throat, and, by holding the mouth and nostrils, was forced into the cavities of the ears, thus removing the singing and other nervous sensibility. The Coroner: In fact, he must have forgotten his lungs, being so wrapped up in what he was doing to the ear. Witness: Yes; he forgot that the vapour was getting into his chest."

Scientific Gossip.—We read in *Les Mondes* that the exclusive right to use Mr. Wilde's machine in France has been purchased by the Alliance Company. This company, we learn, made a proposal to establish an electric light on board the *Great Eastern* while laying the Atlantic cable. The light was to be equal to 125 standard gas-lights, and was to be supplied for the small charge of 240*l.* for the three months. At a lower sum the company offered two machines, one to be placed at the fore, and the other at the after, part of the great ship. We are sorry that the offer was rejected by the Telegraph Company.——Speaking of the uncertainty of the electric light in lighthouses, our valuable contemporary, the *Journal of Gas-lighting*, asks why gas is not supplied to many. There can be no doubt that in many situations this can be easily done, and the illuminating power of the gas increased by naphthalising and other means, according as circumstances may require. We hope this valuable suggestion of our contemporary will not be lost sight of by the Board of Trade and the Lighthouse Boards.——The Emperor of the French has directed M. Bobœuf to furnish him with a report on the use of phenate of soda as a disinfectant in connexion with the army and navy. M. Bohœuf has supplied Garibaldi's army with 100 litres of his disinfectant.——The French Association for the Advancement of Science assembled at Marseilles on the 18th of last month. So far as we can gather from the meagre reports at present supplied, the proceeding offered nothing of particular interest. At one of the sittings a new instrument called a *liquomètre* was exhibited. It is intended for estimating the amount of alcohol in wines, and is based on the principle of capillary action. It consists essentially of a very fine graduated tube. The instrument is said also to give separate indications of the amount of tartar and extractive matter.

Sodium Amalgam. — A paragraph has lately appeared in several papers mentioning that a case marked "sodium" had been thrown overboard from a vessel on which it had been shipped and had violently exploded; also that it was believed to contain, not "sodium," but the new "sodium amalgam" now used for gold and silver extraction. In relation thereto, Messrs. Johnson, Matthey, and Co., of Hatton Garden, who are the manufacturers of these patent amalgams, state that the case in question could have contained "sodium" only, as with the amalgam there is not the slightest danger of explosion or of damage of any kind either by contact with fire or water. It can be shipped with as perfect safety as quicksilver itself. This notification will remove a misapprehension that has already created some difficulty in shipping abroad a material of incalculable value to gold and silver miners, the manufacture of which where most required is impracticable.—*Times.*

Sodium Amalgam.—The New York *Tribune* of June 5 says:—"'Sodium amalgam' is the name of a new explosive compound of California origin. The explosive power of one ounce of this material is said to be equal to that of twenty-five pounds of gunpowder." These three lines contain just three gross errors. Firstly, sodium amalgam is *not* an "explosive compound;" secondly, it is *not* of "California origin;" and thirdly, the explosive power of one ounce of the metal "sodium"—which is the only material in sodium amalgam that of itself is explosive—is *not* "equal to that of twenty-five pounds of gunpowder." —*American Journal of Mining.*

British Association for the Advancement of Science.—The thirty-sixth meeting will be held at Nottingham, commencing August 22, 1866. The opening address will be delivered in the Theatre, on Wednesday, August 22, by W. R. Grove, Esq., M.A., Q.C., F.R.S., &c., President elect. Two *soirées* will be held at the Exhibition Building, Shakespeare Street on the evenings of Thursday the 23rd, and Tuesday the 28th of August. An evening lecture will be delivered at the Theatre, on Friday, the 24th, and one on Monday, the 27th of August, at eight o'clock. One of the lectures will be delivered by J. D. Hooker, Esq., M.D., F.R.S., V.P., L.S., F.G.S. Excursions of scientific interest will take place on Saturday, the 25th, to the Midland Railway Works at Derby, Eastwood, Riddings, Cinder Hill, Annesley, and New-

stead Abbey; and on Thursday, the 30th, to the Derwent and Wye Valleys and Charnwood Forest. The two latter will be respectively under the management of the Derbyshire and Leicestershire Committees. Luncheon has been kindly offered to members of the Association at the above places, by the following noblemen and gentlemen:—The Duke of Devonshire; the Duke of Rutland; W. F. Webb, Esq.; William Perry Herrick, Esq.; Ambrose L. Phillipps de Lisle, Esq.; Messrs. Barber and Walker; J. Oakes, Esq.; Thomas North, Esq.; W. Worswick, Esq.; the Directors of the Midland Railway Company; the Mayor and Corporation of Derby; the Midland Scientific Association, &c.

The Hot Air Burner.—Dr. Letheby has written to the *Journal of Gas Lighting* as follows:—"I am afraid I unwittingly did injustice to Dr. Frankland, when, in my lecture 'On the Combustion of Gas for Economic Purposes,' I spoke of the hot-air burner as having been 'originally designed by Mr. Bowditch, and somewhat modified by Dr. Frankland;'* for it appears, from information which I have received from Dr. Frankland, that he never heard of Mr. Bowditch's invention until he saw the account of it in my lecture. I am, therefore, anxious to set the matter right, and to say how I came to mistake the facts. In the year 1853 or 1854 I received from Mr. Bowditch one of his hot-air burners; and in the summer of 1855 I wrote a description of it for a work I was then preparing, 'On the Chemistry of Artificial Light.' The work was hastily written, and was published anonymously in 1856, by Messrs. Orr and Co., in their 'Circle of the Sciences.'† At page 27 of the work I thus described the invention: 'The Rev. Mr. Bowditch, of Wakefield, has contrived an apparatus whereby this (the heating of the air) may be effected in the case of common gas. He places a disc of metal, or a cup of glass, having a hole in its centre, upon the screw which receives the burner. This disc or cup is made the means of supporting an outer glass, and thus of directing the air down over the surface of the hot chimney before it enters the flame from below. It is stated that the light is increased about 25 per cent. by this arrangement.' In the early part of 1861, I saw for the first time the account of Dr. Frankland's double-cylinder gas burner; and as the drawing of it was somewhat different from the drawing which I had given of Mr. Bowditch's contrivance, I erroneously thought that it was a modification of Mr. Bowditch's. This error I am anxious to correct, by saying that there cannot be a doubt of Dr. Frankland having originated the invention, without any knowledge of what Mr. Bowditch had done, for he informs me that he showed it to many friends at Manchester early in the year 1854, and that he has described it in his lectures at Owens College, Manchester, and at St. Bartholomew's Hospital, and at the London, and the Royal Institution of London for years past. It would seem, therefore, that the arrangement was designed about the same time by both Dr. Frankland and Mr. Bowditch, and that the invention was original in each case."

Preservation of Lemons.—A correspondent of the *Pharmaceutical Journal* (Mr. Mee) writes that lemons may be preserved by the very simple process of varnishing them with a solution of shellac in spirit of wine. Fresh lemon juice is thus obtainable at all seasons of the year; and if the peel be required for flavouring, the skin of shellac may be easily removed by simply kneading the elastic lemon in the hands.

Preparation of Oxygen.—The following is a process patented in France by MM. Maréchal and Tessie du Motay. The inventors decompose in a retort at an elevated temperature highly oxygenated salts, such as chromates and bichromates, manganates and permanganates, condensing aqueous vapour, and collecting the oxygen in a gasometer. The residue left in the retort is peroxidised again by the action of heat and a current of dry air. The inventors also propose to decompose sulphuric acid at a high temperature, fixing the sulphurous acid by means of magnesia. The sulphite of magnesia they decompose by heat, and convert the sulphurous into sulphuric acid in a leaden chamber to be decomposed again.—*Bulletin de la Société Chimique, &c.*, May, 1866, p. 398.

Use of Alum in Iron Safes.—A Vienna manufacturer makes fire-proof safes, in which a certain space is filled with powdered alum. When the heat reaches this, the water of crystallisation is driven off, by which a great absorption of heat is produced and the temperature of the interior of the safe kept proportionately low.—*Bulletin de la Société Chimique*, p. 400.—[This process has been long adopted in England. Ammonia alum is used for the purpose.]

Preparation of Hydriodic Acid and Iodides.—Pettenkofer gives the following modification of Liebig's process:—Using the same proportions, he takes the 15 grammes of phosphorus with 360 grs. of water at 60° or 70° C., and first adds 30 grammes of the iodine, and agitates well. The hydriodic acid formed is decanted upon the unused iodine (210 grammes). A portion of this dissolves in the hydriodic acid, and the solution is poured back upon the phosphorus and shaken until it is decoloriaed. This plan is repeated two or three times until all the iodine is disolved and only a little amorphous phosphorus left. The hydriodic acid is then distilled off. The syrupy residue contains phosphoric and phosphorous acid, which, by treatment with nitric acid containing a little nitrous vapour, is easily converted into syrupy phosphoric acid. The hydriodic acid may be employed in the preparation of iodides. Its density will be about 1·39. By neutralising with bicarbonate of potash, crystals of pure iodide of potassium will be obtained.—*Annal. der Chem. und Pharm.*, cxxviii., p. 57.

Preparation of Bones for Manure.—Illienkof, a Russian chemist, gives the following process, which, it is said, has received the approbation of Liebig:—The author mixes 4000 kilos. of ground bones with 4000 kilos. of wood ashes containing 10 per cent. of carbonate of potash, and adds 600 kilos. of quick lime. This mixture he places in a tank or fosse with water suffieient to make the whole moist. In a short time the bony matter is completely disaggregated by the caustic potash, and the pasty mass formed is then taken from the tank, dried, mixed with an equal weight of mould, and is then ready to be distributed. We can easily believe that a preparation of this kind is a far better manure than superphosphate.

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. *Private* letters for the Editor must be so marked.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

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W. H. D.—Received too late for insertion this week.

M. Rodwell's article will appear next week

C. C.—Send a specimen to the Editor.

D. H.—We commence a tolerably full abstract to-day, and shall give the tabular results in detail. Respecting the corrections, we will communicate with the editor of the work in question.

* Chemical News, last volume, p. 296.

† Dr. Letheby takes this opportunity of making it known that the edition of this work now in course of publication is issued against his wishes and consent.

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INTERNATIONAL EXHIBITION, 1862.—Highest Award for Great Excellence in Design, Material, and Construction of Cameras, the skill shown in the contrivances for the convenience of the Photographer, and the workmanship and general finish possess much excellence.—See Report of Jury, page 9, Class 14.

PHOTOGRAPHIC SOCIETY OF SCOTLAND, 1863.—PRIZE MEDAL.—Extract from Report of the Prize Award Committee. (Vide "Photographic Journal," May 15, 1863.)—" . . . But the only Camera possessing peculiar merit is that by Mr. Meagher, the Binocular Camera, which comprises in itself all the best features of other Cameras, and is suitable either for Stereoscopic Pictures, Carte de Visite Portraits, or for Views the whole size of the plate (7½ by 5)). For this Camera the Committee would recommend that Mr. Meagher receive a Medal."

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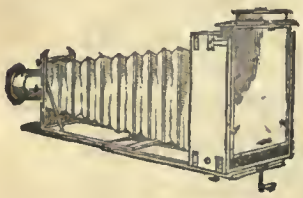

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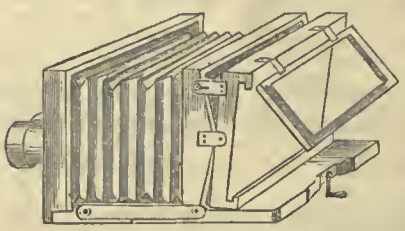

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THE

CHEMICAL NEWS

AND

Journal of Physical Science.

Edited by] [*Wm. Crookes, F.R.S.*

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Friday, 24th August—Lecture at 8.30 p.m., in the Theatre, by W. Huggins, Esq., F.R.S., F.R.A.S., On the Results of Spectrum Analysis applied to the Heavenly Bodies.

Monday, 27th August—Lecture by J. D. Hooker, Esq., M.D., D.C.L., F.R.S., &c., On Insular Floras.

Tuesday, 28th August—Soirée in the Exhibition Building.

Saturday, 25th August—Excursions to the Midland Railway Works at Derby, Eastwood, Riddings, Cinder Hill, Annesley, and Newstead Abbey.

Thursday, 30th August—Excursions to the Derwent and Wye Valleys, Charnwood Forest, and Belvoir Castle.

On and after July 30th, until August 17th, Life Members, who intend to be present at the Meeting, may receive their Tickets by applying to the General Treasurer, and returning to them their Life Member Invitation Circular; Annual Subscribers, who wish to receive their Tickets, must return their Invitation Circular, with £1 enclosed, to the General Treasurer, W. Spottiswoode, Esq., 50, Grosvenor-place, London, S.W.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On Certain Reasons for Doubling or otherwise Multiplying Chemical Formulæ, by John A. R. Newlands, *F.C.S.*

In a paper "*On the Constancy of Quantivalence*" (Chemical News, May 18, 1866), I showed how certain cases in which elements appear to depart from their usual quantivalence may be rendered non-exceptional by the simple process of doubling the formulæ of their compounds. Thus I proposed to look upon carbonic oxide as C_2O_2, the two atoms of carbon interchanging two affinities, &c. I also mentioned at the same time that "if we double the formula of carbonic oxide, we must also double those of water, ammonia, and in fact all, or nearly all, others, in order to preserve the relations between their volumes in the gaseous state."

When I afterwards (June 21) made a similar proposition during a discussion which took place at the conclusion of Dr. Debus' lecture at the Chemical Society, Dr. Williamson admitted it to be "a very convenient proposal," but stated "that the density of carbonic oxide would not accord with it." To this I replied by saying that I would at the same time double the formulæ of hydrochloric acid, water, etc. The present communication is simply a sketch of certain reasons why the formulæ usually assigned to these and other bodies should be doubled or otherwise multiplied.

1. **Argument drawn from Probabilities or Chances.**—Admitting that there is an equal number of atoms of hydrogen and of chlorine in the molecule of hydrochloric acid, we have no proof what the absolute number really is. This may be any conceivable sum from one to infinity, and therefore the statement that the hydrochloric acid molecule contains only one atom of hydrogen and one of chlorine is a mere assertion; it is only one possibility out of millions of possibilities, and consequently there are millions of chances to one that it is wrong. The same may be said regarding the formulæ of water, ammonia, and marsh gas. To obviate this objection to the present formulæ, we may attach an x to the various symbols, as representing the unknown constant indicating the number of atoms contained in the various formulæ; thus hydrochloric acid would be $HxClx$, water would be H_2xOx, ammonia H_3xNx, and marsh gas H_4xCx. The value of x being uniform, the above formulæ would simply indicate (without making any assertion whatever as to the absolute number of atoms in the several molecules) that the number of atoms of hydrogen contained in the molecule of water was twice as great, in that of ammonia thrice as great, and in that of marsh gas four times as great, as the number contained in the molecule of hydrochloric acid.

2. **Argument from Geometrical Considerations.**—We may regard the atoms of bodies in the gaseous condition as so many infinitesimally small points, or centres of force, distributed through space, not filling it, but merely occupying it, or indicating its boundaries, so as to exclude, under particular conditions, certain kinds of matter from entering therein. Now, if we consider what will be the lowest number of atoms required for occupying, or pointing off, so to speak, a portion of space having three dimensions, four will appear to be the lowest that can be taken. Thus, we may imagine the form of a four-sided pyramid to be indicated by four points, one being placed at each of the four corners. We may therefore conclude that the molecule of hydrochloric acid contains at least two atoms of hydrogen and two of chlorine. It is, indeed, almost inconceivable that the single atoms of hydrogen and of chlorine usually supposed to exist in the molecule of hydrochloric acid could be capable of occupying the same space as the three atoms of hydrogen and one of nitrogen in the molecule of ammonia.

3. **Argument from the Nature of Elementary Molecules.**—If we admit that the molecules of all elements contain at least two atoms, we must consider the molecule of cadmium as CdCd, and that of mercury as HgHg; the corresponding volumes of hydrochloric acid, water, ammonia, and marsh gas, would be formulated thus: H_2Cl_2, H_4O_2, H_6N_2, and H_8C_2.

4. **Argument from Certain Abnormal Vapour Densities.**—Instead of regarding the four volumes occupied by chloride of ammonium and pentachloride of phosphorus as due to dissociation, we may look upon them as representing the true state of affairs, and double other formulæ to make them correspond to the same volume. Thus we may suppose that nitrogen and phosphorus are really quinquivalent, as in NH_4Cl and PCl_5, and that in ammonia, an equal volume of which would contain N_2H_6, the two atoms of nitrogen interchange two affinities, and therefore, when united, are only capable of fixing six atoms of hydrogen. In like manner, the two atoms of phosphorus in P_2Cl_6 may be considered as interchanging two affinities, the phosphorus thereby becoming apparently trivalent.

5. **Argument from Certain Proposals for Classifying the Elements.**—The elements have been divided by Dr. Odling and others into two classes—viz., perissads and artiads, or elements of uneven and those of even quantivalence. Now, this distinction is not of a very satisfactory character, and it disappears if we double the formulæ, as then all the elements become united with an even number of atoms.

6. **Argument from Exceptions to the Constancy of Quantivalence.**—This has been already alluded to, and we have seen how those who maintain the constancy of quantivalence are compelled at the same time to double many, if not all, chemical formulæ.

In conclusion, I may say that I would on no account employ the doubled or multiplied formulæ for any save a special purpose, such as showing how exceptions to an otherwise general law may be removed. In fact, for all ordinary purposes the simpler the formulæ we employ the better, and those at present in use, such as HCl, are as simple as they could possibly be.

Laboratory, 19, Great St. Helen's, July 17.

Note on the Discovery of Oxygen and of Sodium, by George F. Rodwell, *F.C.S.*

Within the last six months two extracts, containing some rather remarkable assertions, have been inserted in this journal—the one from a Manchester paper, which informs us that oxygen was discovered by Swedenborg half a century before Priestley; the other a communication to the *Mining Journal*, from a Mr. John Calvert, who endeavours to prove that sodium was known to the ancients.

Now there is not a particle of reliable evidence in support of either statement.

It is scarcely worth alluding to the claims of Swedenborg, founded as they are upon a very obscure and unintelligible passage from the works of a man who, in the eighteenth century, wrote in a style worthy of the most cabalistic writers of the tenth and two following

centuries, who possessed much of their spirit of secresy and concealment, and assumed much of their jargon. Moreover, these claims are unsupported by experimental evidence. We are quite unable to comprehend by what contortion of the meaning of the principal passage quoted, Swedenborg can be supposed to allude to oxygen. "Air," he writes, "consists superficially of fifth finites, and within it are enclosed the first and second elementaries." And again:—"The fifth finites have entered into the surface of the aërial particle, and the first and second elementaries into the internal space." There is no possible reason for assuming that by the meaningless term *fifth finites* oxygen gas is alluded to, and if there were any evidence at first sight it would speedily be nullified by the fact that Swedenborg afterwards speaks of *crystals* of this matter. It is useless to pursue the subject further; the only evidence in support of the supposition is so utterly shallow that it is not worthy of criticism, for it carries with it its own refutation.

Then as regards the discovery of sodium. Mr. Calvert, in order to support his assertion, quotes a passage from Roger Bacon's "Ars Omnia," in which, among other things, it is stated that salt can be transmuted into a metal which, in its turn, can transmute other metals into gold. Now, there is no proof that sodium was procured before the nineteenth century, and no direct evidence upon which to found such an assertion; there is no account in the works of any old writer of its preparation, or of the distinctive properties of any metal even approaching it in character. The statement that the "metal of salt" can transmute other metals into gold, at once settles the question, and proves that no reliance can be placed upon the assertion. We may state, *en passant*, that if any one of the old chemists was more likely than another to have discovered sodium it was Glauber, who worked more with salt chemically than perhaps any of his predecessors; he also attributed to it the most extravagant virtues, maintaining that it was first created, and that the elements were evolved from it.

The statements of the alchemical writers must be received with great caution, and the chances of their probability must be carefully weighed in the mind before any credence is given to them. We give below an example of the matter contained in these works; and as the statement supposed to refer to the discovery of sodium is taken from the writings of Roger Bacon, we have taken the following from the old translation of the treatise "*De Mirabili Potestate Artis et Naturæ*," one of the most famous compositions of the same author:—"There may be made instruments of navigation without men to row in them; as huge shippes to brooke the sea only with one man to steere them, which shall sail far more swiftly than if they were full of men. And chariots that shall move with an unspeakable force without any creature to stirr them. . . . Moreover, instruments may be made wherewith men may walk on the bottom of the sea or rivers without bodily danger . . . . and it is certaine that there is an instrument to flie with, which I never sawe, nor know any man that hath seen it, but I full wel know by name the learned man that invented the same. . . . The Queen of Tormery in Great Britany seeking after a white hart, lighted upon an ointment wherewith the keeper of the forest had anointed his whole body, the soles of his feet only excepted; he lived three hundred years without corruption, save that he was troubled with gout in the feet. And we have observed many countrymen in our days who without the counsel and advice of physicians have lived a hundred and three score years or thereabouts."

We conceive it is fair reasoning to maintain that if one statement is to be accepted literally, other statements of the same author given under like conditions have a right to be similarly treated; if therefore we admit that the passage quoted by Mr. Calvert proves the discovery of sodium at an early date, we must also admit that the above extract proves that the steam engine (or some other powerful motive machine not dependent upon animal force), diving apparatus, a machine to enable a man to fly, and a means of prolonging life far beyond the natural term, were known to the ancients. But here we arrive at a palpable absurdity; hence on this evidence alone (even supposing we did not possess the crushing evidence conveyed in the statement that the "metal of salt" transmutes other metals into gold), we have good ground for ignoring the very dubious passage quoted by Mr. Calvert, and we are compelled to admit, that, like the greater number of assertions in the same work, it is unintelligible and unexplainable. Q.E.D.

To take an individual passage from an obscurely written work, and to found upon it the claims of its author to some great discovery attributed to a much later period, is a very pernicious practice, and can lead to no good result. It has been thus in both the cases discussed above. Nevertheless, if there is a particle of sound evidence in favour of an assumed discovery, let it by all means be brought forward, for in the discussion to which it leads the real discoverer is likely to be found. As Mr. Mill very justly observes, "However unwillingly a person who has a strong opinion may admit the possibility that his opinion may be false, he ought to be moved by the consideration that however true it may be, if it is not fully, frequently, and fearlessly discussed, it will be held as a dead dogma, not as a living truth." That which applies to the opinion of an individual, obviously applies equally to the one opinion of a distinct community.

The man who assumes on good mental evidence, or who even partially proves by actual experiment, the existence of a something unknown before, is never recognised by the world as its discoverer. If such were the case, Lucretius was the discoverer of carbonic acid, Kunckel of ammoniacal gas, Majow of oxygen and nitrogen, and Paracelsus of hydrogen. It is the man who proves absolutely by some conclusive series of experiments that the something possesses properties distinct from all known entities—it is this man who is recognised as the true discoverer. The Copernican theory of the earth's mobility was a "dead dogma" until Galileo made it a "living truth;" and the same principle has obtained throughout the whole history of science.

The attribution of a discovery to a man who lived prior to the universally recognised discoverer, is a dangerous and difficult matter, and should never be attempted except with extreme caution, and upon the soundest and most reliable evidence. That evidence should be rigidly tested by the works of contemporary authors; the entire writings of the assumed discoverer should be carefully studied; and the train of thought which led to the discovery should be followed in its minutest ramifications. The historian of science should endeavour to grasp the precise mode of thought of the man of whom he writes, to think as he thought, to view phenomena in the light of the age in which he lived, and thus to reason on them as he reasoned. He

must specially beware of coming too hastily to a conclusion, for let him bear in mind that an opinion universally accepted, has not been received by mankind without much inquiry as to its value, and much discriminative examination of its validity.

PHARMACY, TOXICOLOGY, &c.

Facts relating to Magnesium: its Action on Metallic Solutions, and its Application to Toxicological Researches, by M. Z. Roussin.*

Every chemist is aware how uncertain, and how often at variance with the theory as well as the principles of the established classification, is the precipitation of a metal contained in a saline solution by a metal apparently more oxidisable. Whether secondary reactions, the presence of water, the nature of the acid, or the conductibility of the solution complicate a reaction which *a priori* seems so simple, it is certain that several metals have hitherto resisted precipitation in a metallic state by the contact of another metal with their aqueous solutions.

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All these metals freed by washing from saline liquid, dried and then compressed, possess great metallic brilliancy, and entirely dissolve in acids. Iron, cobalt, and nickel so obtained are highly magnetic; zinc takes the form of a large spongy mass, which the least compression renders brilliant.

Magnesium precipitates equally silver, gold, platinum, bismuth, tin, mercury, copper, lead, cadmium, and thallium.

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Salts of chromium and of manganese form deposits by their contact with plates of magnesium, which have the characteristics of oxides of these substances, and which we reserve for further study.†

Arsenic and antimony are not precipitated from their acid solutions by contact with magnesium; they combine with the hydrogen gas which is formed in this reaction, and pass off as arseniuretted or antimoniuretted hydrogen.

Magnesium very readily decomposes water; in a very weak solution of common salt, of sal ammoniac, of some acid, &c., the metal will be oxidised, and a considerable disengagement of hydrogen take place. This gas is extremely pure, for the magnesium contains no silicium.

The foregoing qualities encouraged the hope that a substitution of magnesium for zinc in ordinary piles would offer a great electro-motive force. Direct experiment confirms this theoretical inference. A small plate of magnesium, 0·1 gr. in weight, placed beside a plate of copper in a small tube of glass of six centimetres cube, filled with acidulated water, produced in nearly ten minutes an electro-magnetic appearance, and illuminated a Geisler tube 10 cent. long. If magnesium should ever become cheap, this would decidedly be the best way of producing electricity.

The preceding facts appear to us above all to give a special interest to toxicological researches on metallic poisons. A few words on the subject are necessary to give a clear idea of the importance of this new application of magnesium. In all true chemical researches respecting the diagnosis and extraction of compound metallic poisons, the experimentalist, after having destroyed the viscus, or any other organic matter under his analysis, at last finds a greater or less proportion of either a saline or an acid liquid, in which he has to discover and determine the minute proportions of poisonous metal. Whatever the agent used in the destruction of organic matter—whether sulphuric acid, chlorine, aqua regia, or nitric acid—the ultimate liquid is always very complex. Over and above the poisonous substance which it may contain, there is always a great deal of soda, lime, magnesia, phosphoric acid, hydrochloric acid, &c., &c.; and also in most cases, whether colourless or slightly coloured, it contains some strictly organic substances, which are the necessary result of the action on such energetic agents as chlorine, aqua regia, and nitric acid.

In most cases it is possible to find and to separate the metal which determines the poisoning by a methodic use of such tests as hydrosulphuric acid, hydrosulphate of ammonia, &c. But not only do these processes, even in the hands of the most experienced chemists, offer but a limited sensibility, and are sometimes powerless merely from the effect of the complexity of the liquid under analysis, but they necessitate the sacrifice of a great quantity of the liquid in the indispensable preliminary researches. The use of the pile recommended by eminent toxicologists in isolating and precipitating poisonous metals contained in these liquids, has always given us incomplete results, and experience teaches us in this case that if the theory is favourable the practice leaves much to be desired.

Every chemist knows how rapid and complete in some cases is the precipitation of one metal by another in saline solutions. Several toxicologists, struck by the precision of this mode of precipitation and its ease of execution, have proposed its use in the toxicological researches of certain metals. We will limit our examples to the precipitation of arsenic by copper (Reinsch's process), of mercury by tin or by copper, of copper by iron or by zinc, of antimony by tin, &c. These different experiments present two serious difficulties, to mention which will justify our remarks:—

1. The search for every poisonous metal requires a distinct operation and the employment of a different metal for precipitation; hence the necessity for numerous manipulations, and the considerable loss of the matters used in the experiments which these successive analyses necessitate.

2. The introduction into the liquids under analysis of metals either poisonous themselves, such as copper and zinc, or expensive ones, such as tin, presents grave dangers, and it may in some cases render the operation

* *Journal de Pharmacie et de Chimie*, iii., 413.

† I have recently observed that a sodium amalgam shaken up with acidulous salts of chromium and manganese changes to an amalgam of chromium and manganese. The last two amalgams, purified by washing in acidulated water, then distilled in a current of hydrogen, leave the pure metals in the form of a pulverulent sponge. The amalgam of manganese is opalescent and crystalline; that of chromium is more fluid and less variable at the ordinary temperature. If the latter is heated in a small porcelain capsule in the air, the vapours of mercury mechanically carry away particles of chromium, which produce, whilst burning in a darkened room, a singular scintillation which ends in the sudden incandescence of the rest of the metallic chromium.—Z. R.

impossible even to the expert chemist if the poisoning is not precisely determined by the metal employed as the agent of precipitation, and which is partly dissolved in the liquids under analysis.

Were there a metal completely destitute of poisonous properties which the chemist might fearlessly introduce in excess into his liquids, and which had the property of precipitating all the metals whose salts are used by poisoners or which might occasion accidents, there is no doubt but that such a metal would enormously facilitate the researches of legal chemistry. Now it seems to us that magnesium offers all these advantages, and may thus be of the greatest service.

There are now prepared and offered to commerce great quantities of nearly pure magnesium. The original materials and the processes of its manufacture quite drive out of its composition the poisonous metals most dreaded by chemists—copper, lead, mercury, antimony, arsenic, zinc, &c. It is drawn into long slight ribbons well fitted for the delicate experiments of the laboratory; it keeps equally well in a dry or moist atmosphere, and placed in a corked bottle it is safe from any alteration; its low equivalent displaces the ordinary poisonous metals by relatively small proportions of the precipitating metal. Magnesium and its compounds present no danger; it is one of the metals normally contained in the tissues and fluids of the animal economy, and the introduction of them into liquids to be analysed does not cause the least difficulty. The silicium which was found in the first samples manufactured is now seldom seen; and it is easy to understand that the presence of some thousandths or hundredths of silicium or of soda would be no hindrance in the toxicological researches under discussion. Let us add (although the consideration is of small importance in such serious analyses) that the price of magnesium is now very moderate, and it will no doubt become still more so, should the demand increase. A rapid sketch of the reactions produced by the contact of a plate of magnesium with the different acidulous metallic solutions does away with any necessity for entering into the details of the specially toxicological operation. We will merely give a summary.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday Evening, June 1.

The Opalescence of the Atmosphere. By Dr. H. E. Roscoe, *F.R.S., Professor of Chemistry at Owens College, Manchester.*

Ladies and Gentlemen,—By the investigations of Professor Tyndall, so ably expounded here at the commencement of this session, you have become acquainted with some of the interesting relations which he has discovered respecting the phenomena of absorption and distribution of the heating rays. These rays are, as you are aware, situated at and beyond the red end of the coloured beam of light which we term the spectrum. Situated at and beyond the blue or most refrangible end of the spectrum, are other rays which, although they do not possess the same heating power which the red and the ultra-red rays exhibit, play a not less important part in the phenomena of nature. These rays, by their rapid vibrations, are capable of producing amongst the atoms of which matter is composed that deep-seated change to which we give the name of chemical action, and hence these rays have been termed the chemically active rays. Although it is not in my power to lay before you either so completely or so eloquently the relations of these chemical rays as you have had the relations of their lower vibrating brethren at the red end presented to you, yet one or two points have lately come under my notice with respect to the distribution of these chemically active rays in the atmosphere which may not prove uninteresting.

Let me, in the first place, show you that beyond the blue we have rays which we cannot see, but which are capable of being rendered visible by the action of fluorescent bodies—bodies which, when exposed to this invisible blue light, have the power of absorbing it and giving off light of a lower degree of refrangibility. In this way we can render the ultra-blue rays visible. This I shall now endeavour to show you. (A ray of light from the electric lamp was passed through coloured glass and caused to fall on the white screen.) Here, you see, we have by means of this coloured cobalt glass absorbed or cut off all the rays but these very deep violet rays. These and the non-visible rays beyond will be rendered more visible to you when we allow them to fall on a piece of quinine paper. You observe here the immense difference of luminosity between those portions of light which I throw on the quinine paper and those portions which fall on the ordinary screen. This is because a large number of rays which are ordinarily invisible to the eye, and which we do not see when they fall on the screen, are now rendered visible to the eye by the action of the quinine paper. These are the chemically active rays. If we were to expose a photographic plate to the action of these rays, we should obtain a picture. We should be able to get chemical action in these blue and ultra-blue rays which we could not get in any other way.

Now allow me to show you in another way that we do thus get chemical action from the blue rays which we do not get from the red. I have here the means of producing a strong red light, and means of producing an equally strong blue light; and I hope to be able to show you that the red light will not produce chemical action, but that the blue light will. I will burn a piece of phosphorus in a red globe containing oxygen, and then I will afterwards burn a piece of phosphorus in a blue globe containing oxygen. Here I have a little bulb containing a mixture of chlorine and hydrogen, upon which the red rays will not act, and upon which the blue rays will act. We have a very bright red light, but my little bulb containing the mixed chlorine and hydrogen does not explode. I next burn a piece of phosphorus in the blue globe of oxygen, and on exposing the bulb to the blue light it instantly explodes. (The action of the blue light exploded the bulb containing the hydrogen and chlorine, as anticipated by the Lecturer.)

On a previous occasion (May 22, 1864) I explained in this place a method by which the intensity of these chemically active rays can be measured, and their distribution on various points of the earth's surface be determined. I will not trouble you this evening with a description of the method which I employ for this purpose. I will only say that it is founded upon two facts. The first is that the measurement is made by the determination of the tint attained upon sensitive photographic paper when exposed to the action of the light. When I speak this evening of the chemically active rays, you will be good enough to understand that I mean all those rays wherever they may lie in that bright-coloured band, whether in the blue, beyond the blue, or elsewhere—all those rays which have the power of blackening the paper sensitised with chloride of silver. And then we must know, in the second place, that we can prepare a paper which is of a perfectly constant degree of sensitiveness. This can be done. We must also know the relation that exists between the intensity of the acting light and the tint produced. That we have also learned; and thus we are now in a position to measure the intensity of the chemically active light falling from the total heavens, or directly from the sun,

under every changing circumstance of time, position of the sun, condition of the heavens, and position as regards latitude and longitude of situation. The observations can be made by means of the little apparatus which I hold in my hand, and the whole arrangement can be packed up in a small box and carried from place to place, and the observations can be very readily made — indeed, those needed for a whole day can be made in a few minutes. (See "Bakerian Lecture," *Phil. Trans.*, p. 605. 1865.)

In the first place, then, I will direct your attention this evening to the results of a series of measurements which have been made, through the kindness of Mr. Balfour Stewart, at the Kew Observatory, by Mr. Baker. The results of these observations for the last year I have tabulated on a long curve, which I have hung round the room. This gives the curve of the daily mean chemical intensity of total daylight at Kew Observatory from April, 1865, to April, 1866. I should say that the observations are made at various stated intervals during the day, and then by a very simple process of integration, the value of these various determinations made during the day can be summed up, so that we get for each particular day a number which gives us the amount of chemical intensity acting during the day, if our measurements have been made correctly and in sufficient number.

In the first place, then, on joining the numbers thus obtained for each particular day, we get this remarkably varying curve which gives us the daily mean from April 1, 1865, to March 31, 1866. The general features of this curve will be noticed—the gradual rise from the shortest day up towards the summer and backwards towards the autumn, according to the varying altitude of the sun. It will be at once seen from this curve that the greatest amount of chemical action did not take place on the longest day, or in the months in which the days are longest —namely, June and July; but, on the contrary, May and September of last year were the brightest months chemically, September being the maximum. And thus we see how very much the character of the weather, the cloudiness of the atmosphere, and so on, influence the amount of chemical action which falls upon any given spot. I have here the numbers giving the monthly means for these particular months derived from the numbers from which this curve has been constructed. You will observe here that the month in which there was the greatest amount of chemical action last year was September—of course I am speaking of Kew. The month of July was more intense than the month of June. I have here given the numbers for spring, summer, autumn, and winter.

Daily Mean Chemical Intensities of Total Daylight measured at Kew Observatory, April, 1865, to April, 1866.

For April, 1865	81·2	For October, 1865	29·2
„ May „	97·0	„ November „	12·8
„ June „	76·9	„ December „	6·9
„ July „	100·6	„ January, 1866	13·4
„ August „	82·5	„ February „	24·2
„ Sept. „	110·2	„ March „	32·2

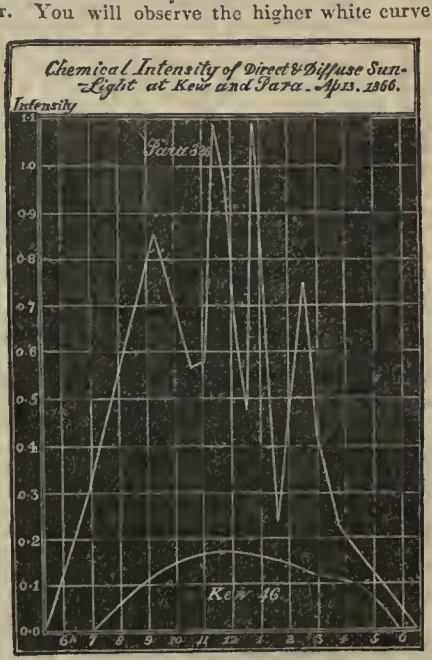
In Spring.	In Summer.	In Autumn.	In Winter.
45·9	91·5	73·9	11·0

(Light of the intensity 1, acting for 24 hours, taken as 1000.)

You observe how the amount increases from dark December which is 6·9, up to July which is 100, and to September which is 110.

If we examine the curves of chemical intensity as measured at Manchester on the longest day, or the autumnal equinox, and on the shortest day, or the winter solstice, we see that the increase of chemical action from December, during the first half of the rise, is not nearly so great as the increase in the latter half —that is to say, the increase from December to March, or the decrease from September to December, is much less than the increase from March to June, or the decrease from June to September. Now this difference is more than can be explained by the absorption exerted by a colourless atmosphere, and I think that we must look for an explanation of this fact to a property of the atmosphere which has been, indeed, noticed and spoken of before, but to which I wish this evening to direct your attention, and to which I have ventured to give the name of the "*opalescence of the atmosphere.*"

It has frequently been stated that amongst the snowy peaks of the Alps and in the glaring sun of the tropics the intensity of the chemically active light is less than we find in our own latitude. It has been stated that photographers in the Alps have had to expose their plates in order to obtain photographic pictures for a very much longer time than is the case in gloomy England or on the level of the sea, and that persons who went to Mexico have even been unable to get a photographic picture at all, and have had recourse to their sketch-books. Now, this extraordinary statement certainly required some definite proof, and I was fortunate enough to be able some few months ago to send my assistant, Mr. T. E. Thorpe, to the Brazils, through the kindness of Messrs. Alfred Booth and Co., of Liverpool. He took with him one of these apparatus for the purpose of making experiments for me on this and some other subjects. He has lately sent me from Para some of his results, which I am glad to be able to show you this evening. They are the first determinations of chemical intensity, the first measurements of light, which have been made relatively in our latitudes and under the equator. You will observe the higher white curve gives



the intensity of the chemically active light at Para, which is situated about a degree and a quarter south of the equator on one of the southern mouths of the Amazon, and the lower curve gives the chemical intensity as observed at Kew Observatory on the same day. In the first place, I would call your attention to the enormous difference which exists in the intensity of the chemical action at these two positions.

Relative Chemical Intensity at Para and Kew.

	Kew.	Para.	Ratio.
April 4, 1866	19·7	260·0	13·1
„ 7 „	9·3	320·0	34·4
„ „	45·7	326·0	7·1

You will notice, to begin with, the very great variation in the chemical light. You will observe how the curve at Pará ascends very rapidly in the morning and more rapidly descends in the afternoon. Now, this time of the year—April, May, and June—is the rainy season at Pará, and on these particular days I see, from the description of the weather which has been sent with these results, that a large thunderstorm passed over, as is usual, every day from three to four o'clock, deluges of rain fell, and of course the chemical action was reduced to zero. Hence, then, we get these extraordinary curves and these extraordinary variations in the intensity. If we find out what the value of the whole of this curve is, we shall see that it is 260 for Pará, and if we find the value of thia whole curve for Kew, we see that it is 19·7, so that the amount of chemical action at Pará was just seven times as great as it was at Kew. I should mention that at Kew observations are made only at certain stated times, and all we can do is to join the lines here, and thus we get a much more regular curve, and perhaps not quite an accurate curve, but it is as near as we can get it with only a few observations, whereas at Pará we have a great number of observations, and hence we get these very great variations in the curve which become evident to us. Whatever was wrong, therefore, for the photographers near the equator, and whatever prevented the success of their operations, it was certainly not a want of chemical action in the light. Probably, instead of exposing their plates about 1-50th of the time required in this country, they exposed them about fifty times too long, and thus the failure of their pictures may have resulted from their being over-exposed. At the end of the diagram you have a drawing, giving you the action at Heidelberg and at Manchester on the same day. This shows that even at Heidelberg and Manchester very great variations take place—exceedingly great variations—and you will also observe the much less intensity of the chemical light at Heidelberg than at Para, remembering that this Heidelberg curve is drawn to the same scale as these curves at Pará.

I would, however, this evening especially direct your attention to some experiments which appear in some degree to explain that much-vexed question concerning the blue colour of the sky and the red tints at sunrise and sunset. Since the time of Leonardo da Vinci this subject seems to have been a favourite ground of speculation amongst the meteorologists. Leonardo thought the blue colour of the heavens was due to a mixture of white sunlight with darkness from surrounding space. In this speculation he was afterwards supported by Goethe, who held certainly very remarkable views, as we all know, on the nature of colour. Newton explained the blue colour of the sky by the existence in the air of minute hollow vesicles of water. These vesicles were supposed to float about, and were generally invisible; but they would produce the result which we obaerve—namely, the blue colour of the heavens—inasmuch as by the phenomena of interference, as on a soap-bubble, the colours of thin plates would become perceptible; and according as the thickness of the walls of these vesicles increases, so would the colour change from blue to yellow, orange, and red, and by frequent reflections the various colours from sky-blue to sunset red could be explained. This theory has been since supported by the eminent German physicist, Clausius, who has calculated what the intensity of the light would be under the assumption of the existence of these small vesicles. Other physicists have given various explanations. Some have said that the varying colours of sunrise and sunset—especially the varying colours of different sunsets—are not due to any real colour that is present, but that it is an ocular deception caused by the presence of clouds which receive and repeat the colour. Other physicists, especially Brücke, have expressed their opinion that the atmosphere is filled with small solid particles which have the effect of producing that appearance in the atmosphere which we know as opalescence in certain minerals and finely divided substances; whilst Professor Forbes observed that aqueous vapour, or at any rate small particles of water, have the power, under certain circumstances, of allowing only the red rays to pass through. Thus, for instance, he noticed that, if he looked at the sun through a jet of steam escaping from a locomotive boiler, the sun appeared like a red ball as we see it in a fog; and hence he explained the colour of the sun by the existence of this water, whether it be in the form of vapour or in the form of finely divided particles.

Now, until we are acquainted with some quantitative results as to the relative intensities of light coming directly from the sun as sunshine, and of the light reflected from the heavens, it appears to me idle to think of explaining with certainty this very important and intereating, but very difficult, question. By means of the method which I have alluded to, it is possible easily to determine the intensity at any rate of that part of the light which we should expect to show great differences—namely, the most refrangible portions, to which, as I have said, the name of chemically active rays has been given. For this purpose it is necessary simply to expose a paper in this little instrument to total daylight—that is, to the direct sunlight as well as the diffuse light from the whole sky—and then to expose another piece of paper in the same instrument, but to bring a little black ball between the sun and the paper, so that a shadow is cast on the paper. The diameter of this ball, seen from the position of the sensitive paper, is only a very little greater than the apparent diameter of the sun, and hence very little of the light from the sky round the sun is taken away, but simply the direct sunlight; and in this way we get the diffuse light coming from all the heavens to act on the paper, and then if we subtract the light emitted by the whole heavens except the sun, from the total light, that, of course, will give us the light that the sun sends. I am speaking now, you will please to underatand, of the chemical light.

The results which were thus obtained were certainly, to begin with, rather startling, as they show that the amount of chemically active light which comes as direct sunshine is very much less than one would suppose—very much less than the amount of *visible* sunshine, compared with the intensity of the visible light coming as diffuse light from the whole sky. Thus, for instance, at Manchester, which is not a very favourable place for observing the maximum effect of the chemical action of light, when the sun was 20° above the horizon, if 100 rays fell as diffused light from the whole heavens, only 10 fell as direct sunshine; or, in other words, of 100 chemical rays which fell altogether on this piece of paper at Manchester, only about 8, speaking roughly, came from the direct sunlight, although the sun cast a very dark shadow, and although the amount of visible light which came from the sun—I mean that which affects the eye—and the amount which came from the sky were in very different proportions. Thus, of 100 rays affecting the eye, 60 came from the sun and only 40 from the sky. Now, this result was borne out by further experiments—experiments which were made by my friend Mr. Baxendell, of Cheetham Hill, near Manchester, whose co-operation I have to acknowledge with great pleasure; by Dr. Wolkoff, at Heidelberg, who forwarded me some results he obtained there, through Professor Bunsen; by Mr. Baker, at the Kew Observatory; and by Mr. Thorpe, at Pará on the Amazon. The results bear out this same fact, that the relative amount of chemically active light which comes directly from the sun is very much less than the amount of visible light which comes direct. Thus, for instance, it was very frequently found at Manchester and Heidelberg, and at Kew, when the sun was shining brightly enough, although it was not very high perhaps, but when it was certainly at a height of 12° of altitude, bringing this little ball and casting a shadow on the paper made no difference chemically; or, in other

words, the direct sunlight did not produce any chemical action. The sunlight had been entirely robbed of its chemical power in passing through the air. Now, this fact will be seen by examining the table which follows :—

Chemical Actions at Heidelberg.

Altitude.	Direct Sun.	Diffuse Light.
0° 34′	0·000	0·026
1 32	0·000	0·024
2 29	0·000	0·038
3 27	0·000	0·028
6 0	0·000	0·030
10 40	0·000	0·073
11 51	0·000	0·079
12 58	0·000	0·080

The following numbers show that if the sky sends down light of the intensity 1, then the direct sunlight has an intensity of only 0·106, or a little more than one-tenth ; and even when we reach a height of 26° at Owens College, Manchester, the amount of chemically active light coming direct from the sun is very slightly increased. The same thing was observed at Cheetham Hill. I should mention that these observations were made on a cloudless day, when we had nothing but a bright, clear sky. Now, at Heidelberg, the same experiments were made on the top of a hill which, as those who have been to Heidelberg will know, is called the Königstuhl, and this hill is about 2000 feet above the sea's level, so that we have a great deal of the air—the densest part of the air—below us when we are on the top of this hill. Hence we find that the ratio of the direct to the indirect sunlight increases very much more rapidly—that is to say, when the sun's altitude reaches 40°, the sunshine there is as strong as the whole diffused light of the heavens.

Results of Observations at Heidelberg.

	Number of observations.	Range of altitude of sun.	Mean altitude of sun.	Intensity of sky or diffused daylight.	Intensity of direct sunlight.	Ratio of sun to sky.
Group 1	10	0° to 15°	7° 15′	·048	·002	0·041
2	19	15 — 30	24 43	·134	·066	0·472
3	31	30 — 45	34 34	·170	·136	0·800
4	22	45 — 60	53 37	·174	·263	1·511
5	17	above 60	62 30	·199	·319	1·603

Results of Observations at Cheetham Hill.

	Number of observations.		Mean altitude of sun.	Intensity of sky or diffused daylight.	Intensity of direct sunlight.	Ratio of sun to sky.
	Sky.	Sun.				
Group 1	23	24	19° 30′	·064	·012	0·187
2	22	22	25 31	·091	·019	0·208
3	18	17	34 8	·104	·026	0·250

Results of Observations at Owens College.

	Number of observations.		Mean altitude of sun.	Intensity of sky or diffused daylight.	Intensity of direct sunlight.	Ratio of sun to sky.
	Sky.	Sun.				
Group 1	33	34	17° 8′	·066	·007	0·106
2	20	24	26 38	·074	·008	0·108
3	4	5	54 12	·140	·043	0·308

Results of Observations at Kew.

	Number of observations.		Mean altitude of sun.	Intensity of sky.	Intensity of direct sunlight.	Ratio of sun to sky.
	Sky.	Sun.				
Group 1	18	18	12° 55	0·065	0·014	0·213
2	8	8	21 8	0·072	0·030	0·416
3	7	7	28 16	0·104	0·056	0·538
4	6	6	41 23	0·135	0·107	0·792

Results of Observations at Para, Brazils.

	Number of observations.		Altitude.	Diffuse intensity.	Intensity direct.	Ratio.
	Sky.	Sun.				
Group 1.	20	20	42° 21′	·451	·168	·372
2	25	25	62 49	·552	·277	·501
3	25	25	77 20	·660	·267	·404

If we compare the numbers thus obtained by experiment with those calculated by Clausius on the theory of hollow vesicles impeding the passage of the rays, we shall notice a most remarkable difference between the experimental and calculated numbers—

Ratio of Chemical Intensities of Direct Sunlight to Diffuse Light.

Sun's altitude.	Calculated (Clausius).	Experiments.		
		Heidelberg.	Cheetham Hill.	Owens College.
20°	0·491	0·350	0·19	0·10
25	0·896	0·480	0·20	0·11
30	1·320	0·650	0·23	
35	1·690	0·820	0·26	
40	2·032	1·00	—	
50	2·634	1·37	—	
60	3·129	1·60	—	

whereas at Kew it is not so strong, and at Owens College it is very much lower indeed. If we come, lastly, to the results at Para, we find that there, very remarkably, the direct sunlight is comparatively very weak—that is to say, the ratio of the diffused to the direct sunlight is but small. At Pará, just under the equator, when the sun's altitude reached nearly 80°, the sunshine was really only half as strong as the diffused light of the whole sky. From these results you will conclude that these very high curves, showing the increased intensity under the equator, are due not so much to an increase of the chemical brightness of the direct sunlight as to the immense increase in the amount of diffused light.

Now, how can we explain this certainly very remarkable fact of the very small relative amount of chemical intensity which the sunshine exhibits? I think we may do this best, perhaps, by an experiment. I have here a very slightly milky liquid, very slightly opalescent; it contains a very small amount of sulphur in suspension. I have placed some of this water in this little glass vessel, and in this other glass vessel I have placed pure distilled water. Now I want to show you that this very slightly milky liquid will cut off the chemically active rays, so that I shall not be able to explode my little bulb of chlorine and hydrogen which I place behind this milky liquid. I will then move the bulb in front of this vessel containing the pure distilled water, and I think you will see that the chemically active rays of light will pass through the pure water, and we shall effect an explosion of the mixed gases in the bulb. (The experiment was performed as described.) The same thing may be seen if we take a piece of this magnesium wire and burn it at the back of this vessel containing the milky water. You will see that the light of

this bright-burning magnesium appears red, or at any rate yellow, when we look at it through this medium containing the finely divided sulphur in suspension, whereas the light reflected by the same liquid is blue.

This is exactly the state of things in the atmosphere. There is something in the air which acts upon the sunlight exactly as that finely divided sulphur acts upon the light from the burning magnesium wire; and I hope I may be able to show you the effect of a larger quantity of this sulphur. Here, I am going to put a very small quantity of finely divided sulphur into this tube, and we will fill the tube with water. Now the tube is filled, I send a beam of light from the electric lamp through it, and here we have a deep red beam of light falling on the screen, exactly the colour of the sun seen through a dense London fog. You observe that this liquid is only very slightly opalescent, but we have got a comparatively long column of it, through which the light has to pass before reaching the screen. You may have a liquid so slightly milky or so slightly opalescent that it appears clear and transparent; but imagine a column of it many miles in length, and you will then understand how it is possible that the sun appears red when it sinks to the horizon or when it rises from the horizon. We will introduce a little more of the sulphur into the liquid in the tube. You see it has now become darker, and here we have a very fair red sun. The small particles of sulphur allow the red rays to pass, but they do not allow the chemical rays to pass. I have made experiments, which show that if by means of such finely divided sulphur I diminish the intensity of the visible light to one-third, I take out altogether the chemically active light. Every particle of this chemically active light is taken away by means of this yellow fog, and we get the blue rays reflected. This is exactly what happens in the atmosphere. Another illustration of this, certainly as good as the one I have shown you, is an opalescent glass. Here I have such a glass, and you see at once the difference between the light when I put on the opalescent cover, and the light when the cover is off. When the glass is put on, the flame appears quite red, but a great deal of white light is reflected from the little particles which are suspended in this glass. Those particles consist of phosphate of calcium, and they allow the red rays to pass, but the blue rays cannot pass through. This I will show you by means of the electric lamp. (The theatre was darkened, and a beam of electric light was passed through the opalescent glass, and received as a red image on the screen.) Here you see the effect of the light passing through this really white substance, consisting of finely divided particles—a substance which has the power, therefore, of allowing the red rays to pass, but of entirely cutting off the blue.

We cannot tell exactly what the substances are in the atmosphere which thus act as the opalescent body—I mean the substance which reflects the blue and transmits the red. But we do know that the atmosphere is full of small solid particles floating about. We see that this is so from a great variety of circumstances. We know that liquids which are exposed to the air gradually undergo fermentation. The presence of little sporules of vegetable matter floating about in the air causes the peculiar change which we call fermentation. We know, too, that we cannot leave a piece of metal or any other substance exposed to the air for an instant without that substance obtaining a trace of sodium, which is instantly rendered visible when the substance is exposed to the flame. We see these particles as motes dancing in the sunbeam, and in those grander paths of light shooting up into the air from a setting sun. If these sporules and particles of solid matter are floating about in the air, they will certainly cause this opalescence. This opalescence may, however, be due to the phenomenon observed by Forbes—the power of small globules of water to produce the same effect.

That the size of the particles through which the light passes has, at any rate, something to do with the question is very evident when we come to consider that very beautiful example of colour produced by finely divided substances about which this audience has frequently been interested—I mean those beautiful colours of ruby gold so ably investigated by Mr. Faraday. I have here some of the original ruby gold solution which was produced by Mr. Faraday some nine years ago. This has been standing in the laboratory downstairs, but it has not yet deposited its metallic gold. It has still its bright red colour, and this bright red colour is due to suspended particles of metallic gold, as has been most beautifully shown by Mr. Faraday. Nobody who has read his paper can doubt for a moment that the blue colour which we see here is caused by finely divided gold, which only allows blue light to pass through it. Here, again, we have a purple gold liquid, here we have a crimson gold liquid, and here we have a ruby gold liquid. In all these, metallic gold in different states of division is the cause of the colour, and in time—if not in eight years, perhaps in eight times eight years, or some still longer period—this ruby gold will sink down, and we shall have a colourless liquid left above it.

Now, to what is this variation of colour due? Is it not due to a variation in the size of the particles? Is it not possible that the variation in the size of the particles of matter present in the air may produce a change as distinct as we see here in the gold? for we read and we have evidence of the sun appearing even blue on several occasions; thus in the year 1831 the sun was seen blue over a large district of Europe and America, and it is a very remarkable fact that a singular fog was observed in that year, which I believe spread even as far as the shores of America. We can also get sulphur in a blue condition. If we precipitate the sulphur from a solution of sulphuretted hydrogen in water by means of iron perchloride, you will observe that at the moment when the sulphur is precipitated we have a splendid purplish-blue colour. This seems to be blue sulphur. Now, is this colour due to the particles being exceedingly small, and does the sulphur then allow only the blue light to pass and reflect the red? Here we have another example of a deep indigo blue, caused by something which at least appears to be sulphur. It is yellow sulphur, which is dissolved in colourless anhydrous sulphuric acid. We do not know what the colour is caused by unless it is the sulphur, for we are not aware that there is any combination which takes place, and it is a singular thing that we repeatedly find sulphur having this particular blue colour when it is exceedingly finely divided. Thus, for instance, if we take a solution of sulphuretted hydrogen in water, and heat it in a sealed tube up to 200° C., we get a deep blue liquid, and when this liquid cools, the particles of sulphur collect together, and it separates out in its ordinary state. It is a singular fact that tellurium and selenium also have the power of producing coloured liquids with fuming sulphuric acid. I have here an olive-green liquid, formed by adding selenium to sulphuric acid, and this splendid red colour is due to the presence of tellurium in the sulphuric acid. Tellurium itself, we know, is a black powder when not in this extreme state of division.

I feel that in proposing these questions I am entering upon debatable ground—that, namely, of the colours of natural bodies. It is therefore with diffidence that I bring forward these examples of coloured liquids as caused by finely suspended particles, and I do so only because they force themselves on my notice in the consideration of the plainer and now somewhat better understood phenomenon of the opalescence of the atmosphere.

The Lecturer, before retiring, called the attention of the audience to a new magnesium lamp constructed by Mr. Henry Larkin. The lamp was suspended from the ceiling of the theatre. Dr. Roscoe stated that the lamp made use of the magnesium in the form of a fine powder which was

caused to drop from a tube through a jet of burning gas, upon which it took fire and emitted a brilliant light. The lamp had never before been exhibited in public.

ACADEMY OF SCIENCES.

July 9.

The proceedings of the Academy continue to have but little interest for chemists. At the last meeting, M. Pisani presented a note "*On a Black Spinelle.*" It forms one of the constituents of the lherzolite of Auvergne, and occurs generally in the shape of simple octahedra—sometimes, however, pyramidal. It is extremely hard, infusible, and not attacked by acids. It takes, moreover, a beautiful polish. An analysis led to the formula (MgFe) (AlFe).

M. Gripon presented a note "*On the Conducting Power of Mercury for Heat.*" Experiments made after Peclet's method showed that if the conducting power of silver = 100, that of mercury = 3·54. It stands therefore the last of the metals, and a little before marble and gas coke. The author mentions that in this case the conducting power for heat and for electricity are very different, the former being 3·54, the latter 1·80.

M. Ch. Mène sent the "*Analysis of a Copper Ore from Corsica,*" the accuracy of which, he said, he could guarantee. It is a peacock ore, and may be, M. Mène says, $FeS + 2CuS$, or $FeS_2 + Cu_2S$.

M. Maumené distributed at the meeting the third part of his memoir "*On the General Theory of the Exercise of Affinity,*" in which he demolishes, to his own satisfaction, the theory of chemical types and the principles of substitution. These, he says, are really one and the same idea, false in itself, and therefore incapable of leading to exact consequences. Affinity, he goes on to say, is not a distinct force, but the resultant of two forces or systems of forces—the attractive or cohesive forces, confounded under the name of cohesion; and the repelling force—heat, to which we might give the name *dishesion*.

NOTICES OF BOOKS.

Journal für praktische Chemie. Nos. 6 and 7. 1866.

No. 6 is almost entirely occupied with contributions by R. Hermann, among which we have an account of a series of researches undertaken to decide *whether or not norium exists.* Swanberg, in 1845, fancied that he had discovered that zirconia was a mixture of at least two different earths, and to one of these, which he obtained by fractional precipitation with oxalic acid, and to which he assigned a lower atomic weight than that of zirconia, he gave the name *Norerde*, or, as English chemists say, *Noria.* Few chemists have since then occupied themselves with this body. The supposed metallic base *Norium* is placed in the list of elements in most books on chemistry, but it has generally been regarded as a body of doubtful existence. All doubts have now been removed by Hermann, who has found differences in zirconia of various origins—mainly from admixture of alumina—to account for the facts on which Swanberg based his fancied discovery. Hermann has investigated—1. *The specific gravity of zircon;* 2. *The specific gravity of zirconia;* 3. *The composition of the sulphate prepared from the precipitates obtained by the fractional precipitation of chloride of zirconium by oxalate of ammonia;* and 4. *The behaviour of this fractionated zirconia towards sulphate of potash.* Reviewing all his results, Hermann concludes that it may be safely asserted that Swanberg's norium does not exist.

The same author has next a series of papers "*On the Separation of Zirconia from Titanic Acid and some other Substances,*" including thoria, the cerium bases, yttria, and oxide of iron. Then follows a paper "*On the Composition of Tschewkinite,*" a rare mineral in which the author finds among commoner substances large percentages of titanic acid, thoria, oxides of cerium, lanthanum, and didymium, yttria, and some uranous oxide. We have next a paper "*On the Amount of Ilmenic Acid in Greenland Columbite,*" and last a note "*On Asperolite,*" a new mineral, essentially a hydrated silicate of copper. The series of papers named above form a most important contribution to the chemistry of the rarer earths and metals, and we shall return to them for the methods of separating some of these.

The rest of this number is principally occupied with a memoir by Dr. K. Haushofer, "*On the Composition of Glauconite.*" The remainder is made up of abstracts from the *Journal of the Chemical Society* and the *Proceedings* of the Royal Society.

No. 7 of the *Journal für praktische Chemie* contains a long memoir by Erdmann "*On the Nitrous Acid Compounds of Nickel and Cobalt,*" in which is described a great variety of compounds of nitrous acid with those metals and the alkalies and earths. A paper by Dr. A. Winckler, "*On the Colorimetric Determination of Cobalt and Nickel,*" separately and in solution together. The author's process and instruments are certainly ingenious, but they probably will not command much attention from practical chemists. The titles of the remaining papers of any importance and not from English sources are as follows:—"*On the Aldehydes of Butylic and Propylic Acids,*" by Michaelson; "*On the Compounds of Hydrochloric Glycide with Chlorinated and Anhydrous Acids,*" by Truchot; "*On a New Method of Distinguishing between Grape and Cane Sugar,*" by Nicklés (this process was given in our last volume); "*On Tyrosin,*" by L. Barth; "*On the Gases in Melted Steel and Cast Iron,*" by L. Cailletet, also noticed by us.

We may state here that for the future we shall, in accordance with the wishes of many readers, give the titles of all the more important papers in the principal foreign journals; while doing so we shall for the most part omit those papers taken from English journals and also the abstracts of those previously noticed in our pages.

Zeitschrift für analytische Chemie. Edited by Dr. C. Remigius Fresenius. Parts iii. and iv. for 1865.

Dr. Fresenius is not to be congratulated on the regularity with which he issues his journal. These parts, published together, which complete the volume for last year, have but lately reached us. They open with a long and valuable paper, by Dr. E. A. Van der Burg, "*On the Cinchona Alkaloids and the Determination of Nitrogen by the Soda-lime Process.*" In this paper the author reviews the processes of De Vrij and Rabourdin for the determination of the alkaloids in bark, giving his preference to the latter both for simplicity and accuracy. In the notice of the process of Will and Varrentrapp for the estimation of nitrogen in the form of ammonia, he shows that it is not to be relied on in the case of many organic bases, and notably the cinchona bases. The differences, indeed, in the results obtained by it are extraordinary, and suggest a fuller examination to decide on the value of the method in any case. The difficulty appears to be so to regulate the heat that the whole of the substance under examination shall be decomposed, but not volatilised; and again, that the ammonia produced shall not be decomposed. This is a very important matter, and we shall return to the paper for a longer abstract.

The next paper is "*On the Estimation of Kreatin in Muscles,*" by Felix Nawrocki, which offers nothing of interest to the general chemist.

A short paper, by A. Chizynski, follows, "*On the Separation of Lime and Magnesia.*" The author gets these bases into the form of sulphates, and then separates them by means of diluted alcohol, in which sulphate of magnesia is soluble and sulphate of lime insoluble. The results obtained by this method, he shows, are very accurate.

The next paper is by Dr. Julius Löwe, "*On the Properties and Composition of the Hydrate of Alumina precipitated from an Alkaline Solution.*" The author describes the precipitate formed in an alkaline solution on the addition of sal-ammoniac, and shows that it has the composition indicated by the formula $Al_2O_3,2HO$.

The same author has next a paper "*On the Quantitative Estimation of Alumina,*" in which he recommends a method which is probably generally adopted by analysts.

Another paper by the same author follows, "*On the Behaviour of Nitrate of Potash and Nitrate of Lead towards a Solution of Basic Acetate of Lead.*" The admixture of solutions of nitrate of potash and basic acetate of lead in slight excess produces a precipitate of $2PbO,NO_5,HO$. Nitrate of lead and acetate give the same compound.

A paper "*On the Solubility of Pure Compact Metallic Copper in Hydrochloric Acid in the Absence of Air*" is also by Dr. Löwe. The author shows that copper is slightly soluble in hydrochloric acid on long boiling, and points this fact out as a source of error in Fuchs' method of estimating iron.

The same industrious author has yet another paper "*On the Estimation of Tannin in Oak Bark,*" in which he confirms the statement of Berzelius that the extract of oak bark contains a considerable proportion of pectic acid. When, therefore, he estimates tannin, he treats the dried extract with alcohol in which pectic acid is insoluble. He then gets rid of the alcohol, redissolves in distilled water, and the tannin can now be determined by the usual methods.

A short note "*On Barium in Platinum,*" by K. Kraut, follows. The author has a piece of platinum wire which gives a green colour to the flame of a Bunsen's burner.

Several other papers in the journal remain to be noticed next week.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

1180. T. W. Tobin, Watson's Road, Wood Green, Middlesex, "Apparatus for effecting a solution of lime for the purpose of softening hard water."—Petition recorded April 27, 1866.

1348. A. V. Newton, Chancery Lane, "Improved apparatus for manufacturing illuminating gas." A communication from L. Stevens and N. C. Munson, Shirley, Mass., U.S.A.—May 10, 1866.

1610. W. H. Hall and J. Cooke, Birmingham, "Improvements in minera' safety lamps."—June 13, 1866.

1667. E. Hunt, St. Vincent Street, Glasgow, "Improvements in dissolving or treating rubber, gutta-percha, copal, and similar gums, or resins, and their compounds."—June 22, 1866.

1721. H. D. Plimsoll, Ampthill Square, Hampstead Road, Middlesex, "The application of a new material to the purpose of rendering gunpowder non-explosive."

1726. C. E. Brooman, Fleet Street, London, "Improvements in obtaining alkaline permanganates." A communication from C. M. T. du Motay and C. R. Maréchal, jun., Metz, France.—June 28, 1866.

1734. H. Hobson, Middlesbro'-on-Tees, "Improvements in smelting iron ores, and in apparatus used with blast furnaces."

Notices to Proceed.

627. W. Weldon, Park Villa, Highgate, Middlesex, "A new process for obtaining soda from common salt."

628. W. Weldon, Park Villa, Highgate, Middlesex, "Improvements in the manufacture of soda from common salt."—Petition recorded March 1, 1866.

671. C. W. Siemens, Great George Street, Westminster, "Improvements in the manufacture of zinc, and in the construction of furnaces connected therewith, which latter improvements are also applicable to other metallurgical processes."—March 5, 1866.

683. J. Norman, Glasgow, N.B., "Improvements in apparatus for reburning, and in apparatus for washing animal charcoal or charcoal substitutes."—March 6, 1866.

1710. W. R. Lake, Southampton Buildings, Chancery Lane, "Improvements in the mode of distilling or separating volatile products from oils and other fluids." A communication from H. L. Smith, Gambier, Ohio, U.S.A.—June 27, 1866.

MISCELLANEOUS.

Royal Society.—The following eminent men of science have been elected foreign members of the Royal Society:—Franz Cornelius Donders, George Friedrich Bernhard Riemann, and Gustav Rose.

Colour of Light.—Dr. Memorsky and Professor Brucke, in a paper communicated to the Vienna Academy, describe diffuse daylight as strongly reddish, just as gas and lamplight is yellow. The only perfectly white light, they say, is the electric light from carbon points. The light of burning magnesium and the combustion of phosphorus in oxygen, they tell us, is violet.—*Journ. für prakt. Chem.*, No. 7, 1866, p. 447.

The Working of the Alkali Act.—Dr. Angus Smith's report for 1865 has just been published. It states that the average condensation is now nearly 99 per cent. A point or two of interest is alluded to in the report, to which we shall return.

The London Cowkeepers and their Petition.—The London cowkeepers have lately presented a petition to Parliament praying for a more extended inquiry on the subject of disinfectants and disinfecting measures. It is much to be regretted that while doing so they should have been prompted to cast some most undeserved aspersions on the character of Dr. Angus Smith. To any one who knows Dr. Smith, or has read his report, it is unnecessary to say a word in reply to this attack, but under the circumstances we feel called upon to make a few remarks in answer to the statements contained in the petition. In the first place, it is certainly quite true that Dr. Smith was "the co-patentee with one McDougal of a disinfecting article sold under the name of McDougal's powder." We have, however, the best reasons for knowing that Dr. Smith has never profited to the smallest extent by the sale of that article, and that, although his name is necessarily connected with the patent, he has for many years ceased to have any connexion with the manufacture of the article, from which, besides, his name has long been divorced. It would, however, have been perfectly consistent in a man of undoubted integrity to recommend an article of his own invention if he really believed it to be the best thing to use under the circumstances; but, in truth, Dr. Smith, in his report published in the Appendix to the third Report of the Commissioners, did not recommend McDougal's powder as a preventive against cattle plague. The reader who will take the trouble to refer to pages 171 and 172 of the Appendix named will find the following words in Dr. Smith's report:—"On account of this small amount of carbolic acid *it* (McDougal's powder) *is not put in the list of substances for fumigation and prevention of cattle plague. Its most fitting use is for preventing decomposition in manures.*" Probably no one of those who signed this petition ever saw Dr. Smith's report, and the same may perhaps be said for the writer in the *Medical Press and Circular* who endorses the statements contained in the petition, and, moreover, has the hardihood to assert that Dr. Smith's report and our own detail only laboratory experiments

Protected Gunpowder.—Mr. Hearder, of Plymouth, has made a series of experiments, which we might say have completely exploded protected gunpowder. In a future number we may give some account of these experiments. At present we may say that Mr. Hearder finds that when confined the so-called protected or non-explosive powder is as explosive as unprotected powder. 2. That in the ordinary process of carriage the gunpowder separates itself from the glass in quantities sufficient to explode and do great damage. 3. That the powder, after having been mixed with the glass and again separated, undergoes changes which injure its quality and reduce its power. 4. That it fouls the interior of the gun, so as to render it necessary to wash it thoroughly after each charge. 5. That in its application to "small arms" this fouling must necessarily injure the interior of the rifle. 6. That although glass dust may be mixed with very coarse powder and separated from it again through coarse sieves, after having lain a short time together, yet the process of sifting, after some months of union, fails to detach all the glass dust, whilst the powder loses its glazed surface, and becomes itself friable. 7. That with the fine powder used for small arms, which constitutes a very large proportion of that in use in the service, the process of sifting would be tedious, incomplete, and impracticable. 8. That since it would be perfectly impossible, under any circumstances, to sift powder and make it up into cartridges rapidly enough to supply a ship or battery during an engagement, or even a regiment of soldiers during or on the eve of a battle, it follows that powder thus necessarily kept in the form of cartridges, &c., of which there are immense stores in many parts of the kingdom, could in no wise have the protecting process applied to it. 9. As all powder must be made into cartridges of exact dimensions and weight, and as it is impossible to afford space for this operation as well as the sifting process on board ship, it never can be used at sea. No one, Mr. Hearder adds, has ever doubted that gunpowder can be rendered non-explosive by many processes, but the question is, to what practical use can the fact be turned?

How to make Nitroglycerine Safe.—Professor Seely, in the *Scientific American*, notices the following methods of "protecting" nitroglycerine:—"First: Mr. Nobel proposes to dilute the nitroglycerine with wood naphtha. These two liquids mingle in any proportion, and the explosibility of the mixture may be reduced to any desired extent. Probably a mixture containing about 25 per cent. of naphtha could not be made to explode by percussion, or gradual heating. When the nitroglycerine is required for use, water is added to the mixture and takes from it the naphtha, while the pure nitroglycerine sinks to the bottom. This plan is, however, liable to serious objections. 1st. The expense of the naphtha and loss of nitroglycerine in washing with water. 2nd. The volatility of the naphtha: whenever the mixture is exposed to air some of the naphtha escapes, and the nitroglycerine might be left unprotected. 3. It is probable that there would be a chemical action between the substances. 4th. The naphtha and the vapour from it are very combustible. The vapour mixed with air would be an explosive mixture. Second: It has been proposed by several persons, quite independently of each other, to keep the nitroglycerine mixed with sand, or other inert substance which should serve as a conductor of heat, in the same way as the glass powder in Gale's gunpowder mixture. This plan would greatly increase the weight and bulk of packages, and great loss would be sustained by reason of the adhesion of the nitroglycerine to the sand. Third: Dr. Henry Wurtz proposes to make a thorough mechanical mixture or emulsion of the nitroglycerine with a saline solution of the same specific gravity. A solution of nitrate of zinc, lime, or magnesia, will probably be found to be suitable. When the nitroglycerine is needed for use, water is added to the mixture, when the oil subsides and may be drawn off. Further experience seems to be needed to determine how long the mixture may be maintained without spontaneous separation. Fourth: I have proposed to prepare the nitroglycerine more carefully, in order that it shall be perfectly freed from acid; and to prevent any future accumulation of acid, I propose to keep suspended in the oil a small quantity of a substance in powder which shall neutralise any acid which may be generated, and which of itself shall have no action on the oil. This method is offered as an efficient prevention of spontaneous decomposition. The amount of neutralising powder required is very little—60 grains to the pound of oil might be sufficient. The quantity is so small that it would not interfere with the use of the oil, and need never be removed from it. In actual practice one or more of these plans may be combined. The fourth is compatible with all the others, and should be used with all the others; nitroglycerine should not be kept in storage unless it is free from the danger of its most formidable property—the liability to spontaneous change. In conclusion, I can say that I have as yet had no reason to modify the opinions which I expressed in my communication of May 5, and that I still hold that the manufacture, transportation, and use of nitroglycerine may be carried on with safety. I believe all the careful and thoughtful readers of this article will agree with me."

Excise Chemistry.—We are indebted to the *Chemist and Druggist* for the report from which we make the following abstract:—

The Commissioners for Inland Revenue charged Mr. Thomas Reade, chemist and druggist, of Cork Street, Wolverhampton, first, with selling methylated spirit without a licence; and, secondly, with selling certain methylated spirit, coloured and flavoured, to be used as a beverage. A supervisor proved the purchase of three pint bottles of a mixture labelled as follows:—"Reade's Original Indian Essence, a pleasant and effectual medicine, warming and comforting — Antispasmodic, Astringent, Diaphoretic, and Diuretic. Perfectly free from any injurious drugs, and may, therefore, be taken with the greatest confidence. Dose: Adults, one tablespoonful, to be repeated when required; children, one or two teaspoonfuls. Prepared by Thomas Reade, chemist, 9, Cock Street, Wolverhampton. Only 3d. per ounce." Witness took the bottles to his office, in Church Street; and he afterwards forwarded two of the bottles, securely packed, to Somerset House. A portion of the third bottle he gave to the defendant's solicitor, and the remainder he now produced.

Mr. William Harkness, analytical chemist to the Board of Inland Revenue, proved the receipt of the two bottles of the essence produced from the previous witness. He made an analysis of the contents of one of the bottles, and found it to consist of methylated spirit, strength 70·1 under proof, highly sweetened with either treacle or very coarse brown sugar. It also contained a small portion of chloroform. He produced the methylated spirit which he extracted from it. It was not a mixture recognised as a medicine in the British Pharmacopœia.

Cross-examined by Mr. Motteram: Had been in the employ of the Commissioners of Inland Revenue, as analytical chemist, for six years. Could tell from his analysis most of the ingredients contained in the essence. He found treacle present, and water and chloroform. He supposed chloroform was a medicine. Did not find essence of ginger, but would not swear there was none present. Did not try for it. If there was any it was in very small quantities. Did not try for essence of capsicum or for gentian, nor did he find any. The essence had a slightly pungent taste, and he would not swear that capsicum did not contribute to that pungency. Chloroform, and the tinctures of gentian, ginger, and capsicum, were all recognised in the British Pharmacopœia, provided they were made with pure alcohol. He did not find in the mixture any

sweet spirits of nitre. Had there been 100th part of one per cent. he should have discovered it. Methylated spirit was used to a certain extent, he knew, in the making of tinctures, but, in his opinion, no respectable chemist would use it.—Mr. Motteram here handed a list of medicines sent out by the South Staffordshire Hospital in 1864 to be contracted for, specifying thirty-six tinctures made up with methylated spirit, and asked the witness what he thought of that. Witness replied, all he could say about it was, that it was disgraceful.—Mr. Motteram: And all I can say is that the governors of the South Staffordshire Hospital are very much obliged to the chemist of six years' standing for the compliment he has paid them. Don't you know that there is a standing order for their use both in the army and navy?—Witness: I do not.—Mr. Spooner: Do you know whether they are used in the London hospitals?—Witness: I do not.—Mr. Motteram: Why, sir, do you not know that these methylated tinctures are very extensively used by the great body of the surgeons and dispensers in the United Kingdom?—Witness: I did not know it; and my opinion is, if they are so used, the surgeons and dispensers care more for the profit on cheap spirits than for the health of their patients.—Mr. Motteram (sharply): What do you know about it? You're not a physician. If methylated spirit is cheaper, what has that do with it if the poor want it, and it is as good as ordinary spirit?—Witness: But is it as good?

Mr. Spooner: I can't help thinking that medicines made from the pure spirit are the best to use; and I must express my astonishment that an institution like the South Staffordshire Hospital should use any other.

Mr. Motteram: I am told, sir, that methylated medicines are not only cheaper but equally efficacious.

Mr. Richard Banister, another of the analytical chemists at Somerset House, spoke to the analysis of a portion of the essence, which he found to consist of methylated spirit, syrup of sugar, and a small quantity of chloroform.

In cross-examination, witness said that he found no traces of spirits of nitre.

Thia was the case for the prosecution.

The defence was that the compound was a medicine, and that no pure methylated spirit was used in its composition. To establish this, the following witnesses were called:—

Dr. Hill, Professor of Chemistry and Public Analyst for the Borough of Birmingham, was sworn: He said that he was applied to by Mr. Reade to analyse the "Indian essence." He received four samples of the essence. One was a bottle which had been purchased at a shop of a Mr. Cottis; the other three were—a bottle which was compounded at Mr. Reade's, in his presence; a portion of a bottle which came through the Excise; and a portion of methylated spirits of nitre which he saw put into the essence that was compounded in his presence. There was no pure methylated spirit put into the essence he saw compounded. He took four ounces and distilled it for the purpose of extracting the spirit and nitrous ether, and found it to contain nitrous ether with methylated spirit and chloroform. The nitrous ether was an essential element of the sweet spirits of nitre. Upon analysing the sample of spirits of nitre, he found methylated spirit contained in it. He detected the presence of sweet spirits of nitre containing methylated spirit in all the three other bottles of essence. They presented the same analytical results in like proportions. In the preparation of the essence which was compounded in his presence he saw the following among other ingredients used:—Scotch treacle, golden syrup, sweet spirits of nitre, essence of ginger, essence of capsicum, infusion of gentian, and chloroform. There was no pretence for saying that the mixture was anything but a medicine, for everything it contained was a medicine except the treacle and water. Methylated spirit was used very extensively in the preparation of medicines, and the methylated spirit of nitrous ether even more so. The advertisement described the medicine fairly enough; certainly it was diaphoretic and diuretic.

Andrew Hanning, sworn, said that he had been in the employ of the defendant since December last, and during that period had had the mixing of the essence. That prepared for Dr. Hill, in the presence of that gentleman, was made in precisely the same way as in all other instances. There was no pure methylated spirit used. They used, in all cases, methylated spirit of nitrous ether only, and all the methylated spirit ever present was that which existed in the ether. It was used as a medicine, and a medicine only. He had tried it himself, and found instant relief from it. During the time he had been in Mr. Reade's service they had had about forty gallons of methylated spirit of nitrous ether, and only about one gallon of the simple methylated spirit. They had only used about half of the latter, and that was in the preparation of varnish.

Mr. Harkness, recalled by the Bench, said he was quite sure that there was no nitrous ether in the essence.

Mr. Hanning swore positively on his oath that no simple methylated spirit had been used in the composition of the essence. During the time he had been with the defendant they had made altogether from eighty to a hundred gallons of the essence.

This being the case for the defence,

Mr. Spooner, the stipendiary magistrate, said that he was prepared then to give his judgment upon the case. The judgment was subject to appeal, and he was very glad that it could be appealed against, both as regarded facts and law; but with respect to law, he did not think that such a course would be necessary. As regarded the facts, however, it was a very different thing. Three chemists had been called, and had differed in their evidence, as chemists always did—(a laugh)—when employed on opposite sides. It was, he regretted to say, found to be the case that scientific men could always take a scientific view according to the wishes of the party whose cause they were engaged in; and science was not yet so certain but that they could do so conscientiously. It had been urged by the learned gentlemen for the prosecution that the Government chemists had necessarily more knowledge of such points as the one which had been considered than had Dr. Hill, because they were more constantly engaged in analyses of this kind than Dr. Hill, who was only called in on these particular investigations. He would grant, for the sake of the argument, that this was so; and possibly, if he had to decide upon the evidence of the chemists, he might have been inclined to come to the conclusion that those who had come from Somerset House were more likely to be right than Dr. Hill. But it would be seen that the case did not depend solely on the evidence of those witnesses; it went further, because the witness Hanning, who had been in defendant's employ six months, and who knew how the mixture was made—and whose evidence he was inclined to believe, for he appeared to give it in a perfectly truthful and straightforward manner—had sworn positively that no methylated spirits were used. Under those circumstances he should dismiss the case.

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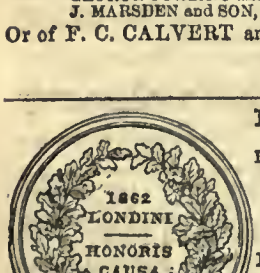

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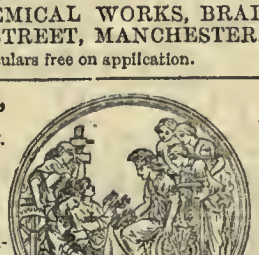

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TABLE of CHEMICAL ELEMENTS. By J. CARTER BELL, F.C.S., Associate of the Royal School of Mines, London.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Proposed Doubling of the Received Chemical Formulæ, by Thomas Stevenson, *M.D. Lond.*

In a paper "*On Certain Reasons for Doubling or otherwise Multiplying Chemical Formulæ*," on page 25 of the current volume of the Chemical News, Mr. Newlands has put forth certain arguments for doubling the generally received formulæ of chemical compounds, in order to do away with certain apparent exceptions to the law of atomicity or quantivalence of the elements; arguments which appear to me, if valid, so damaging to the law he endeavours to support, that I think it may not be amiss to criticise them.

The author's first argument, drawn from the doctrine of chances, beyond giving an air of mathematical precision to the paper, does not state anything more than a truism. But I quite think that Mr. Newlands has employed it merely to show that his hypothesis is, *a priori*, as likely to be true as any other, and that the question must be settled by other considerations. It is only fair to add that the presumption is in favour of the simpler formulæ, and that the burden of proof lies with our author.

I confess that I am quite unable to grasp his second argument, drawn from geometrical considerations. It appears to me that it is at variance with his third, deduced from the nature of elementary molecules. Why the simplest compound molecule should necessarily form a four-sided pyramid (a tetrahedron is evidently meant), I cannot conceive. At the same time, what Mr. Newlands finds "almost inconceivable," that the single atoms of hydrogen and chlorine usually supposed to exist in the molecule of hydrochloric acid should be capable of occupying the same space as the three atoms of hydrogen and one of nitrogen in ammonia, is to me easily conceivable. He himself appears to be able to conceive that the two atoms of hydrogen and the two atoms of chlorine which he supposes to exist in hydrochloric acid may occupy the same volume as the two atoms of nitrogen and the six atoms of hydrogen that he supposes to exist in ammonia; and there does not appear to be much difference in the conceivability or inconceivability of these two suppositions.

Again, if we admit that four is the least number of atoms that can enter into a molecule, as our author requires us to do, it follows that the free molecule of mercury must be represented by Hg_4; and the corresponding volumes of hydrochloric acid and ammonia would be H_4Cl_4 and N_4H_{12}. Will chemists accept these formulæ?

Mr. Newlands regards four volumes as representing the true state of affairs with regard to the vapour of chloride of ammonium and pentachloride of phosphorus—a fact which it would be hardihood to deny; but he appears to reject dissociation as the true explanation of the phenomena, and prefers doubling the usual formulæ of those compounds. As, however, he does not deny the fact of dissociation, and as it affords a sufficient explanation of the anomalies in question, I prefer to hold it, as a provisional hypothesis, in preference to doubling the ordinary formulæ.

The proposed formulæ would represent carbon as entering into all its compounds with an even number of atoms, and would do away with elements of even and uneven atomicity—at least, so we are informed. Why there should not be elements with uneven as well as those with even atomicity, Mr. Newlands does not explain. I see no reason why one class is not as likely to exist as the other. Moreover, why should the least indivisible quantity of carbon entering into a molecule be represented by C_2, and not by C (= 24)? The only reason, I conceive, why the latter representation should not be employed would be that, by making C_2 in carbonic acid exchange two affinities, we get rid of the apparent exception to the quadrivalence of carbon in that compound, which is what Mr. Newlands wishes to do. But then comes the question—What is the quantivalence of carbon in C_2H_6, of nitrogen in H_6N_2, of oxygen in H_4O_2? If, as the theory of atomicity requires, the polyatomic be the binding element in the compound, carbon must exchange here at least two affinities, and be at least quinquivalent; nitrogen must exchange at least two affinities, and be at least quadrivalent; and oxygen must be at least trivalent. Can these values be assigned to C, N, and O in substitution compounds?

I will not pursue the author's arguments further, for enough has, I hope, been said to show that his ingenious hypothesis does not, on the theory of atomicity, do away with the real or apparent exception to the constancy of quantivalence in the case of carbonic oxide, without, at the same time, introducing other and greater difficulties. For the present, I apprehend, we must accept the anomaly as inexplicable.

Laboratory, Guy's Hospital, July 21.

On the Relation of Rosaniline to Rosolic Acid, by H. Caro *and* J. Alfred Wanklyn.

At the meeting of the British Association held in Bath in the year 1864, it was pointed out by one of us that rosaniline and rosolic acid might be represented as ethylene which had undergone substitution—

Type.	Rosaniline.	Rosolic acid.
$C_2\begin{cases}H\\H\\H\\H\end{cases}$;	$C_2\begin{cases}NC_6H_5H\\NC_6H_5H\\NC_6H_5H\\H\end{cases}$;	$C_2\begin{cases}OC_6H_5\\OC_6H_5\\OC_6H_5\\OH\end{cases}$

Rosaniline and rosolic acid became members of the same family, the former being an ethylene containing

$$N\begin{cases}C_6H_5\\H\end{cases}$$

in place of hydrogen, the latter also an ethylene, but containing OC_6H_5 and OH in place of hydrogen. Some of the reasons for assigning these formulæ were given in the communication made to the Bath meeting.

The relationship between rosaniline and rosolic acid is very well brought out by the facts which will presently be brought forward.

Griess has shown that aniline and nitrous acid yield water and diazobenzol—

$$\underset{\text{Aniline.}}{C_6H_5NH_2}+\underset{}{HNO_2}\underset{\text{Diazobenzol.}}{C_6}=H_4N_2+2H_2O.$$

Diazobenzol is a most remarkable compound, forming salts which are very explosive, and which undergo certain very interesting transformations under the influence of reagents. It is moreover the representative of a numerous class of compounds derived similarly by the action of nitrous acid on different bases, and for the most part resembling itself in the explosive character of the salts. One of the most remarkable reactions presented by diazobenzol is that with water, wherein the whole of the nitrogen of the diazobenzol is evolved, and its place supplied by an atom of water—

$$\underset{\text{Nitrate of diazobenzol.}}{C_6H_4N_2HNO_3}+H_2O=\underset{\text{Carbolic acid.}}{C_6H_6O}+HNO_3+N_2.$$

This elegant form of reaction appears to be characteristic of the class to which diazobenzol belongs; and Griess has resorted to a measurement of the quantity of nitrogen set free during the reaction, as a means of arriving at the composition of the azo-compounds.

Hofmann showed some years ago that rosaniline, after treatment with nitrous acid, is capable of forming a platinum compound endowed with explosive properties, but appears not to have followed the investigation further.

Paraf has recently shown that rosaniline salts are converted by nitrous acid into a dye, which he considered to be rosolic acid. We have also investigated the action of nitrous acid on rosaniline, and arrive at the following results:—

When an acid solution of a salt of rosaniline is mixed with nitrous acid, it forms an azo-compound, which corresponds very closely in character to diazobenzol. Like diazobenzol this compound forms explosive salts; like diazobenzol it decomposes with evolution of nitrogen gas when it is boiled with acids. In adding the nitrous acid to the solution of rosaniline to form the compound, it is easy to observe the exact point at which the solution ceases to contain unaltered rosaniline. It thus becomes easy to determine the amount of nitrous acid consumed in the conversion of a given weight of rosaniline into the azo-compound. We have done this by the employment of a method which gives excellent results when applied to aniline and toluidine, and the details of which will shortly be published by one of us. We obtain as the result of our experiments, that one molecule of rosaniline consumes three equivalents of nitrous acid; and the equation representing the reaction will be—

Rosaniline. Azo-compound.

$$C_{20}H_{19}N_3 + 3HNO_2 = C_{20}H_{10}N_6 + 6H_2O.$$

On boiling this azo-compound with hydrochloric acid, there is evolution of nitrogen gas. The volume of nitrogen was measured. The result was that one molecule of rosaniline, after conversion into the azo-compound, yields six equivalents of nitrogen.

Azo-compound.

$$C_{20}H_{10}N_6 + 3H_2O = C_{20}H_{16}O_3 + N_6.$$

These changes in composition are accompanied by striking physical effects. The deep-red solution of the salt of rosaniline becomes brown on the addition of excess of hydrochloric acid, then yellow as the nitrous acid is added; then there is much froth, and as the solution is boiled it gradually becomes red yellow, and a large quantity of a deep-coloured solid with cantharides-like lustre separates out.

Seeing that this solid is produced by treating rosaniline with three equivalents of nitrous acid, and that six equivalents of nitrogen are evolved, it must be a non-nitrogenous substance. A careful comparison of its properties and reactions with those of the rosolic acid described by Kolbe and Schmitt, and now made largely as an article of commerce, leads to the conclusion that it is identical with rosolic acid.

The following characters are common to it and to the rosolic acid of Kolbe and Schmitt:—

1. A yellowish-red solid with cantharides-like lustre, only sparingly soluble in water, soluble in ether and alcohol.

2. Easily soluble in ammonia, and in alkalies generally, forming red solutions of very great colouring power. Addition of acids to these solutions decolorises them, precipitating the colouring matter in the form of a yellowish precipitate, which varies much in tint.

3. When boiled with aniline and a little benzoic acid, it forms a blue dye, there being no evolution of ammonia. The blue dye is very soluble in alcohol, not soluble in water; it is the salt of a red-coloured base. It dissolves in strong sulphuric acid, giving a red solution.

4. Submitted to destructive distillation, it gives abundance of carbolic acid, leaving a carbonaceous residue.

5. The deep-red solutions in alkalies are easily reduced on boiling them with zinc powder; so treated they lose their colour; but restoration of the colour takes place on adding ferricyanide of potassium.

There is only one particular in which any difference could be detected between the product obtained from rosaniline and that obtained from carbolic acid by Kolbe and Schmitt's process.

The rosolic acid of Kolbe and Schmitt forms salts the solutions of which are darkened by ferricyanide of potassium. The product obtained from rosaniline does not darken, or darkens only very slightly, on the addition of ferricyanide. An explanation of this difference is afforded by the following experimental facts:—The product from rosaniline after reduction with zinc becomes capable of being darkened by ferricyanide; and if leucaniline instead of rosaniline be taken, there is obtained a cantharides-like product, which gives red solutions with alkalies, but is darkened by ferricyanide. Furthermore, if a solution of Kolbe and Schmitt's rosolic acid be darkened with ferricyanide of potassium, and then precipitated by the addition of an acid, there results a colour acid which dissolves in alkalies, giving solutions of the exact tint of the rosaniline product, and, like it, incapable of being deepened by ferricyanide. The interpretation of all this is, that the rosolic acid obtained from carbolic acid by the action of sulphuric and oxalic acid (Kolbe and Schmitt) contains more or less leuco-rosolic acid, produced probably by the reducing action of some sulphurous acid. The rosolic acid got from leucaniline also contains more or less leuco-rosolic acid. The rosolic acid obtained from rosaniline is free, or almost free, from leuco-rosolic acid.

Be this, however, as it may, there can be no doubt that rosaniline and carbolic acid give essentially the same product when the former is treated with nitrous acid in the manner we have described, and the latter with sulphuric and oxalic acids as in Kolbe and Schmitt's process.

Adopting the "ethylene type," we have the following expressions for the reactions of rosaniline—

Rosaniline. Azo-rosaniline.

$$C_2\begin{cases} NC_6H_5H \\ NC_6H_5H \\ NC_6H_5H \\ H \end{cases} + \begin{matrix} HNO_2 \\ HNO_2 \\ HNO_2 \end{matrix} = C_2\begin{cases} N_2C_6H_3 \\ N_2C_6H_3 \\ N_2C_6H_3 \\ H \end{cases} + \begin{matrix} 2H_2O \\ 2H_2O \\ 2H_2O \end{matrix}$$

Rosolic acid.

$$C_2\begin{cases} N_2C_6H_3 \\ N_2C_6H_2 \\ N_2C_6H_2 \\ H \end{cases} + \begin{matrix} H_2O \\ H_2O \\ H_2O \end{matrix} = C_2\begin{cases} OC_6H_5 \\ OC_6H_5 \\ OC_6H_5 \\ H \end{cases} + 3N_2.$$

On comparing the formula of rosolic acid given thus by Griess's process applied to rosaniline, we find that it differs from the formula deduced from Kolbe and Schmitt's analysis, viz.—

$$C_2\begin{cases} OC_6H_5 \\ OC_6H_5 \\ OC_6H_5 \\ OH \end{cases}$$

by one atom of oxygen.

We are inclined to think that this difficulty must be got over by correcting the formula deduced from Kolbe

and Schmitt's research. If the numbers required by the formulæ $C_{20}H_{16}O_4$ and $C_{20}H_{18}O_4$ be calculated, it will be found that both of them fall sufficiently near the analytical results actually obtained to allow of the deduction of either from the analyses.

Taking the latter—viz., $C_{20}H_{18}O_4$—all will become intelligible—

Rosolic acid. Type.

$$C_{20}H_{18}O_4 = C_2\begin{cases}OC_6H_5\\OC_6H_5\\OC_6H_5\\H\\H\\HO\end{cases} \qquad C_2\begin{cases}H\\H\\H\\H\\H\\H\end{cases}$$

Thus rosolic acid appears as an ethyl-hydride, and its generation in the Griess process applied to rosaniline is obvious. To the formula

$$C_2\begin{cases}OC_6H_5\\OC_6H_5\\OC_6H_5\\H\end{cases}$$

which is derived from rosaniline by the straightforward action of nitrous acid and water, we have to add H_2O, and we get

$$C_2\begin{cases}OC_6H_5\\OC_6H_5\\OC_6H_5\\H\\H\\HO\end{cases}$$

which is, as was said, a possible expression of the analyses of the rosolic acid obtained from carbolic acid.

On Ozone and Antozone, by M. C. Weltzien.*

M. Schoenbein, who in all chemical combinations considers only the oxygen they contain, and attributes to it all the reactions they produce, admits that this oxygen, whether free or combined, may exist in three different states; as active negative oxygen $\dot{O}$ (ozone); as active positive oxygen $\dot{O}$ (antozone); as ordinary inactive oxygen O, resulting from the union of the two others $\dot{O}$ and $\dot{O}$. Combinations containing active negative oxygen he calls ozonides, and antozonides those containing active positive oxygen. Thus peroxide of lead is an ozonide, $PbO\dot{O}$, and peroxide of hydrogen an antozonide, $HO\dot{O}$; nitric acid, which M. Schœnbein considers as hyponitrate of peroxide of hydrogen, contains these three acids—

$$NO_2 + 2\dot{O} + HO\dot{O}.$$

Under the name of nitrous peroxide of hydrogen (Stickwasserstoff hyperoxyd) M. Schoenbein describes a compound which he gives as—

$$NO_2 + HO_2,$$

which must be nitrous acid..

According to some considerations by the same chemist, ordinary oxygen is susceptible of polarisation; certain bodies polarise it positively, others negatively. Moreover, certain bodies will transform active positive into negative oxygen, or inversely. With this method of interpreting facts it would be difficult to be taken unawares.

Some years ago I had occasion to pronounce against these theories; I showed the hypothesis of the two oxygens to be groundless, unnecessary, and that all the reactions discovered by M. Schoenbein might be explained like other chemical reactions. I also differ from M. Clausius, who considers ozone as the result of the condensation of two atoms of oxygen.

Sir B. Brodie also gives his opinion against M. Schoenbein's interpretations, and places the reactions of ozone amongst the normal chemical reactions; at the same time he claims priority respecting the theories on the polarity of the elements of a chemical molecule.

In 1855 M. Houzeau, whilst making concentrated sulphuric acid react on peroxide of barium, obtained a very odorous oxygen, apparently ozone, and to which he had then given the name of nascent oxygen. M. Schœnbein came upon this reaction in 1861, and he considered the disengaged oxygen as positive active oxygen—that is to say, antozone. M. Meissner says:—"The observations of M. Weltzien against M. Schoenbein's views are based upon this, that the existence of a second active oxygen, antozone, is not proved." We must then examine what foundation there is for the existence of antozone. According to M. Houzeau, the odour of nascent oxygen, although much resembling the odour of ozone, is still very different; its inhalation produces suffocation and even vomiting, which ozone never does; he compares its odour and flavour to that of lobster. His nascent oxygen quickly decolorises litmus, oxidises metals, especially silver, changes ammonia into nitrate, does not ignite spontaneously inflammable phospuretted hydrogen, decomposes iodide of potassium setting the iodine at liberty, and even takes hydrogen from hydrochloric acid; finally, under the influence of light or of a temperature of 75°, it changes into ordinary oxygen.

According to M. Schoenbein, antezone decomposes iodide of potassium; M. Meissner, on the contrary, asserts that this decomposition does not take place, and the latter chemist even uses iodide of potassium to separate antezone and ozone. He thus endeavours to explain the difference of opinion between himself and M. Schoenbein:—"It must be admitted that antozone does not act so energetically upon iodide of potassium as ozone, and it is for this reason, and partly also because of the presence of a great quantity of ozone, that after passing a current of electrified air through a solution of iodide of potassium very little antozone is retained by this salt." Meissner adds, however, that this explanation does not entirely satisfy him.

In Graham-Otto's treatise on chemistry a similar attempt is made to explain this contradiction by saying that antozone cannot provoke the reactions of ozone, except after having been by some means previously transformed into ozone, and here the agent of this transformation is evidently hydriodic acid, displaced from the iodide of potassium by the acid introduced. Other contradictions are found in the same work;† thus, p. 179:—"One cannot conceive a mixture of ozone and antozone." Then p. 181:—"The reactions of ozone are not much hindered by the presence of antozone, if, indeed, they are at all hindered."

According to M. Schoenbein, ozone and antozone are polarised negatively; according to Meissner, a metallic plate placed in antozone does not become charged with electricity. He has been unable to prove the electric state in either ozone or antozone.

The white vapours formed above phosphorus exposed in the air are formed of antozone, according to Meissner; of nitrite of ammonia, according to M. Schoenbein;

* *Bulletin de la Société Chimique*, May, 1866.

† See 4th edition, vol. ii.

Meissner even goes so far as to say "it is evident that these vapours cannot be formed by nitrite of ammonia."

Having stated all these differences, I ask, What is the appearance of antozone, and how does it behave?

We may give the characteristics of this body as—1. It combines with water and forms peroxide of hydrogen. 2. It forms a white mist on contact with this last compound.

As to the formation of peroxide of hydrogen, what happens is this—there is a difference in the manner in which certain peroxides behave; thus, peroxide of barium behaves with water differently to the peroxides of manganese or lead. Instead of attributing this difference to the nature of the metal itself, people prefer resorting to hypotheses, admitting that this difference is due to the nature of the combined oxygen, and supposing that the peroxides of barium and oxygen contain antozone; according to this, if peroxide of hydrogen is formed in a reaction, it is to be supposed that antozone pre-existed in one of the reacting bodies, and that this antozone, uniting with the water, produced the peroxide of hydrogen. M. Meissner thus explains what passes in the electrification of the water:—"At the same time as the ozone, antozone is produced, if not free at least combined with water—which comes to the same thing."

M. Houzeau's nascent oxygen freed from the peroxide of barium by sulphuric acid is, he says, antozone. Why? Because, says M. Meissner, the liquid contains peroxide of hydrogen; and yet we obtain this body by the action of acids upon peroxide of barium, and we should have reason to be astonished were it not produced in this reaction, for a small portion at least ought to escape the decomposition produced under the influence of temperature. As to the property which antozone possesses of producing vapours on contact with aqueous vapour, we find in Meissner's memoir the following, which ought to explain the formation of ozone and antozone in the action of phosphorus on air, and the action of antozone on water:—

"The phosphorus produces ozone and antozone in surrounding oxygen; it polarises neutral oxygen, and consequently acts on oxygen as a body charged with electricity. The phosphorus seizes upon the ozone to form phosphoric acid, whilst what antozone remains free unites with the water to produce peroxide of hydrogen, forming with the vapour of water the cloud which appears above the liquid."

M. Meissner calls antozone *atmizone*, on account of the white fumes it forms, and he uses the German word *abklingen* to express that atmizone gradually loses its energy, and ends by changing into ordinary oxygen. Chemists are aware that a tumultuous escape of gas and production of vapours often take place without the agency of antozone. It must be noticed that odoriferous oxygen, freed by M. Houzeau's process, and which, according to MM. Schoenbein and Meissner, is antozone, is produced in the presence of concentrated sulphuric acid; it is then dry, and cannot consequently produce any vapour.

(To be continued.)

Reactions of the Sulphates of Quinine and Quinidine.—Schwarzer points out a difference in the behaviour of chlorine water, ferrocyanide of potassium, and ammonia towards sulphate of quinine and sulphate of quinidine. With both, it is true, a red coloration is obtained; but in the case of quinine the red colour disappears after a few minutes, while with sulphate of quinidine a bulky persistent precipitate is obtained.—*Journ. de Pharm. et de Chimie*, June, 1865, p. 475.

TECHNICAL CHEMISTRY.

A Theoretical Study of the Manufacture of Soda by Leblanc's Process, by M. J. Kolb.* (*Second Part.*)

(*Continued from page* 17.)

The diminution of alkalinity in black ash long exposed to air is attributable to the presence of iron in the ash, which may contain as much as 3 per cent. of that metal. Iron is present in the anhydrous ash in the state of sesquioxide, not sulphide, for sulphide of iron in contact with lime at a high temperature will give oxide of iron and sulphide of calcium. As long as the ash is exposed to air without moisture, the peroxide of iron undergoes no change; but when moisture intervenes, the peroxide becomes hydrated, and now acts on the sulphide of calcium, producing sulphide of iron and lime.

The moist sulphide of iron oxidises in the air, and finally becomes the sulphate $(Fe_2O_3)2SO_3$, which is again destroyed by the lime, forming sulphate of lime and reproducing peroxide or sulphide of iron. The changes with the sulphide or peroxide then recommence, and thus a very small proportion of iron is sufficient in moist air to transform a large proportion of sulphide of calcium into sulphate of lime.

To sum up the results of the experiments:—They show that crude ashes exposed to perfectly dry air are not sensibly altered, however long the exposure may last. Over-roasted ashes, or ashes containing sulphide of sodium, may, indeed, be benefited by the exposure, the sulphide of sodium becoming converted into hyposulphite. At 100° dry air is equally without action, but as the temperature rises beyond that, and especially at a red heat, the sulphide of calcium is changed to sulphate of lime, and then, on contact with water, sulphate of soda is produced, and the alkalinity of the ash diminished. M. Pelouze has shown that this diminution commences between 200° and 300°. We can understand now how important it is for the manufacturer to hasten the cooling of the ash, and to effect the cooling in hermetically closed vessels.

The first effect of moisture of the air on ball soda is to hydrate the lime, producing fissures in the balls which separate them into fragments. The hydrate slowly carbonates; hence a small proportion of caustic soda in the leys. At the same time the sulphide of sodium oxidises to hyposulphite.

If these were the only reactions which took place, exposure to moist air would be an excellent thing; but unfortunately this salutary action is counterbalanced by the oxidation of the sulphide of calcium, which becomes sulphated by the direct action of the air, and more especially by the indirect action of oxide of iron previously described. Moist as well as dry air, then, can only be useful to overburnt ash. In general the exposure to air should be limited to the time necessary for the hydration of lime by atmospheric moisture. This hydration facilitates the breaking up of the lumps, which would otherwise be a difficulty with a body so hard as ball soda.

The time of the exposure may vary from three to six days, according to the amount of moisture in the air and the proportion of free lime in the ash; it is seldom that it can be prolonged beyond this without a loss to the manufacturer.

* Abstract from *Annales de Chimie et de Physique*, June, 1866, p. 135. For abstracts of the former part of the author's memoir see Chem. News, vol. xiii., pp. 140, 162.

Before proceeding to the action of water on the crude ash, the author refers again to the composition of the ash. He agrees with MM. Kynaston and Scheurer-Kestner that no caustic soda is to be found in the ash. He believes that although traces of sulphide or bisulphide of sodium may be present in a badly made ash, the monosulphide found in a ley depends on the mode of lixiviation. The iron, as stated before, exists as peroxide, and is only converted into sulphide in contact with water.

M. Kolb next explains the manner in which he has presented the composition of the anhydrous ash (see page 16) which has been used in the experiments to be now described, and points out a distinction which must be made in the analysis of a dry ash and in that of the variable elements furnished by its treatment with water. The analysis of an anhydrous ash, he says, ought and can only indicate lime and peroxide of iron; if it mentions sulphide of sodium, it should only be that obtained by washing with alcohol. The analysis of a lixiviated soda, on the contrary, ought to give the caustic soda and sulphide of sodium as well as caustic lime, all three being variable according to the manner in which the ash has been treated with water. It should also give account of the sulphide of iron, carbonate of lime, &c., which also result from the action of water.†

In the tables which now follow will be seen the changes produced by the action of water under three conditions—1, the proportion of the water; 2, the length of the digestion; 3, the temperature:—

Table 1.—Influence of the Amount of Water.

100 grs. of ash.	In 350 c.c. of water.	In 500 c.c.	In 1000 c.c.	In 2000 c.c.
Digested for 6 hours at 15° C.:				
$NaOCO_2$	,,	38·51	40·19	38·21
NaO	,,	3·32	2·34	3·32
NaS	,,	0·20	0·25	0·20
Digested for 6 hours at 40° C.:				
$NaOCO_2$	,,	37·36	35·92	36·10
NaO	,,	3·94	4·40	4·67
NaS	,,	0·25	0·45	0·50
For 6 hours at 60°:				
$NaOCO_2$	,,	31·49	34·20	37·91
NaO	,,	6·78	5·40	3·34
NaS	,,	0·65	0·75	0·60
For 24 hours at 15°:				
$NaOCO_2$	34·70	38·58	38·56	37·62
NaO	5·70	3·29	3·30	3·84
NaS	traces	0·25	0·25	0·35
For 24 hours at 40°:				
$NaOCO_2$	31·40	35·36	34·23	34·68
NaO	7·80	5·05	6·04	5·94
NaS	0·15	0·40	0·75	0·53
For 24 hours at 60°:				
$NaOCO_2$	31·50	26·80	31·10	33·10
NaO	7·60	6·71	6·62	6·15
NaS	0·30	4·70	2·00	1·00
For a week at 15°:				
$NaOCO_2$	31·50	37·02	35·18	34·50
NaO	7·60	4·23	4·97	5·28
NaS	traces	0·25	0·30	0·51
For a week at 40°:				
$NaOCO_2$	25·80	34·21	31·40	31·50
NaO	9·50	5·67	6·30	6·31
NaS	2·20	0·40	0·80	1·48
For a week at 60°:				
$NaOCO_2$	26·40	25·50	23·20	19·50
NaO	7·20	6·62	6·00	6·31
NaS	3·70	5·90	7·80	10·21

† In a future paper the author intends to give an account of his analytical methods.

Table 2.—Influence of Time of Digestion.

100 grs. of ash.	Digestion lasting 6 hours.	Digestion lasting 24 hours.	Digestion lasting a week.
In 350 c.c. of water at 15°:			
$NaOCO_2$	,,	34·70	31·50
NaO	,,	5·70	7·60
NaS	,,	traces	traces
In 350 c.c. at 40°:			
$NaOCO_2$	,,	31·40	25·80
NaO	,,	7·80	9·50
NaS	,,	0·15	2·20
In 350 c.c. at 60°:			
$NaOCO_2$	,,	31·50	26·40
NaO	,,	7·60	7·20
NaS	,,	0·30	3·70
In 500 c.c. at 15°:			
$NaOCO_2$	38·51	38·58	37·02
NaO	3·32	3·29	4·23
NaS	0·20	0·25	0·25
In 500 c.c. at 40°:			
$NaOCO_2$	37·36	35·36	34·21
NaO	3·94	5·05	5·67
NaS	0·25	0·40	0·40
In 500 c.c. at 60°:			
$NaOCO_2$	31·49	26·80	25·50
NaO	6·78	6·71	6·62
NaS	5·65	4·70	5·90
In 1000 c.c. at 15°:			
$NaOCO_2$	40·19	38·56	35·18
NaO	2·34	3·30	4·97
NaS	0·25	0·25	0·30
In 1000 c.c. at 40°:			
$NaOCO_2$	35·92	34·23	31·40
NaO	4·40	6·04	6·30
NaS	0·45	0·75	0·80
In 1000 c.c. at 60°:			
$NaOCO_2$	34·20	31·10	23·20
NaO	5·40	6·62	6·00
NaS	0·75	2·00	7·80
In 2000 c.c. at 15°:			
$NaOCO_2$	38·21	37·62	34·50
NaO	3·32	3·84	5·28
NaS	0·20	0·35	0·51
In 2000 c.c. at 40°:			
$NaOCO_2$	36·10	34·68	31·50
NaO	4·67	5·94	6·31
NaS	0·50	0·53	1·48
In 2000 c.c. at 60°:			
$NaOCO_2$	37·91	33·10	19·50
NaO	3·34	6·15	6·31
NaS	0·60	1·00	10·21

(To be continued.)

Simple and Economic Process for obtaining Soda from Common Salt.—Mr. Walter Welden has taken out patents for a process described as follows:—The new process consists in placing within a vessel capable of resisting the required pressure an equivalent of common salt, and another of carbonate of magnesia, with a small quantity of water, and then pumping into the vessel the carbonic acid formed by causing atmospheric air to traverse coal in a state of ignition. The carbonate thus becomes bicarbonate of magnesia, which dissolves in the water, and then decomposes the chloride of sodium, chloride of magnesium, which remains in solution, and bicarbonate of soda, which precipitates, being formed. The whole process lasts but a quarter of an hour at most, and the cost is only that of the coal used in forming the carbonic acid. A moderate heat drives off the second atom of carbonic acid from the bicarbonate of soda, changing it into carbonate; and the magnesia may be recovered from the chloride by evaporating the solution containing it to dryness, and raising the residue to a temperature below redness.

PHARMACY, TOXICOLOGY, &c.

Facts relating to Magnesium: its Action on Metallic Solutions, and its Application to Toxicological Researches, by M. Z. Roussin.*

(Continued from page 28.)

The acid liquids obtained from the viscera or other organic matters under analysis are concentrated by evaporation in a water bath, and brought to a syrupy consistence. The residue heated to 125° is redissolved in a small quantity of distilled water, then filtered.

We then arrange one of Marsh's ordinary apparatus, into which we introduce some water acidulated with sulphuric acid, and some grammes of magnesium ribbon. A considerable escape of hydrogen then takes place, which must be carried through a tube at a red heat in the middle, and ignited at the smaller extremity. If no rings are formed on the tube, and no spot on the porcelain plates held upon the flame of the gas, then successively introduce into the apparatus small portions of the suspected liquid. If either antimony or arsenic is present in the liquid, a ring will not be long in appearing, as in the ordinary Marsh's apparatus, and the flame flattened against the porcelain plate leaves there a shiny deposit. The spots and rings of arsenic are distinguishable from the spots and rings of antimony by characteristics known to toxicologists, and which, therefore, it is unnecessary to mention here.

If the suspected liquids contain no trace of arsenic or antimony, they may contain other poisonous metals, such as copper, lead, mercury, zinc, &c. In this case the metals are found as flakes, powder, or sponge, either at the bottom of the flask of the apparatus or on the surface of the plates of magnesium. To render the precipitation complete, the liquids must be kept in a proper state of acidity, and the experiment prolonged till the new plates of magnesium introduced into the liquid dissolve, whilst retaining their metallic brilliancy. To ascertain the end of the operation, it is well to take out at first a small proportion of the liquid of the flask, to put it into a small test tube, and to introduce a well-scoured ribbon of magnesium. However it may be, it is always necessary to leave in the flask a small excess of magnesium before putting the liquid on a filter. All that is in suspension—corroded plates of magnesium, powder, flakes, or metallic sponge—is washed on the filter until the washings show no acid reaction; the filtered liquids should not precipitate on the addition of hydrosulphuric acid. The filter being dried, collect the deposit it contains, and analyse it in the ordinary way to ascertain the metals precipitated by the magnesium.

The limits of an article like this do not admit of the minute details of the operations of the experimentalist and the precautions he ought to take. These precautions and verifications belong to all analyses appertaining to legal chemistry, and every operator imagines, multiplies, and varies them according to the principles of the method he employs and the research he is engaged upon. Here we bring forward merely a note on the formation of solid hydride of arsenic, when the liquids contain nitric acid, and the necessity in the last case of preventing its formation by the addition of some particles of pure sugar candy, according to M. Blondlot's valuable recommendation. Again, we content ourselves with indicating that in a solution of bichloride of mercury the mercury is not all precipitated in a metallic state by the plates of magnesium; a portion forms a deposit of protochloride.

There is one more important observation, the omission of which would not fail to call forth criticism—the magnesium which contains silicium gives off on contact with acids siliciuretted hydrogen, which decomposes at a dull red heat like arseniuretted and antimoniuretted hydrogens, leaving a dark-brown deposit. The formation of this deposit might give rise to an error. Such is the objection. A few words will answer it:—

1. The magnesium which is now manufactured gives no foreign deposit in Marsh's apparatus; no sample of magnesium ribbon (as it is made for burning) tested by us has given either rings or spots. The hydrogen it gives off has always appeared remarkably pure and inodorous; its flame is hardly visible.

2. Marsh's apparatus fed by magnesium is tested under precisely the same conditions as when fed by zinc. The suspected liquids are only introduced into the apparatus after the preliminary verification of the gas-producing agents.

3. The deposit of silicium left in the red-hot tube by the passage for the hydrogen, accidentally charged with siliciuretted hydrogen, is moreover clearly distinguishable from the deposits of arsenic and antimony.

These last two disappear immediately on contact with a drop of nitric acid or aqua regia; the ring and spot of arsenic disappear suddenly when touched with a diluted solution of a hypochlorite. These three tests have no effect on the deposits of silicium produced in the tube of the Marsh's apparatus.

* *Journal de Pharmacie et de Chimie*, iii., 413.

PROCEEDINGS OF SOCIETIES.

ROYAL SCHOOL OF MINES, MUSEUM OF PRACTICAL GEOLOGY.

A Course of Twelve Lectures on Chemical Geology, by Dr. Percy, F.R.S.

Lecture No. VI.

Ladies and Gentlemen,—We proceed this morning with the subject of the anhydrous silicates, and will then immediately take up the hydrated silicates, which form a very extensive and interesting class of bodies.

Before commencing, I will draw your attention to certain specimens on the table before you, which illustrate what I said about devitrification in the last Lecture Here, for example, is a piece of the well-known trap rock, occurring in South Staffordshire in connexion with coal. It is known as the Rowley rag. There were for a long time beautiful quarries of this Rowley rag, presenting fine basaltic columns of the usual form, but these have been long since removed, owing to the excavations which have been made for different purposes, especially for roads. It is a very good stone for that purpose. Now, there is natural stone, the natural trap rock, which was no doubt very slowly cooled. Here is the same rock which has been melted. You see that when melted artificially it forms a perfect black glass, much resembling common obsidian. This was cooled, of course, with very great rapidity, and hence the vitreous property has been acquired. If we take this same glass and cool it very slowly, we then get the appearance of the spheroidal masses of crystals of which I showed you illustrations on the last occasion. You will find in the upper gallery of the Museum some very characteristic specimens of this kind.

The next mineral to which I have to direct your attention is one of no great interest—mineralogically, at all events. It is known as gehlenite, taking its name from the old chemist Gehlen. Gehlenite is a very unattractive mineral,

occurring in square prisms. It is found in limestone, crystallised, in syenite, in the Fusser Thal, in the Tyrol. You will see the crystals diffused throughout the mass. In the course of many years' search among furnace products I met with one specimen of gehlenite, or of a substance which is identical crystallographically and chemically with gehlenite. That is now a good many years ago. It came from a furnace in some iron works, in South Staffordshire, near Birmingham and Oldbury. Here is the specimen. It differs at first sight, indeed, very sensibly from the natural gehlenite; but it has been very carefully examined by Professor Miller, of Cambridge, undoubtedly the best observer we have in that line, and its crystallised form has been accurately determined by him. I made some very careful analyses of it some years ago, and found the composition to be identical with that of gehlenite. This substance was produced in a blast furnace at a very high temperature. Whether the gehlenite which we find in the Tyrol has been produced in exactly the same conditions, I think is very doubtful. It may possibly be a product of hydrothermic action, but of that we require further information. This is the only instance on record, as far as I know, of the artificial formation of this mineral. The formula is $3(3CaO,SiO_3) + 3H_2O_3,SiO_3$.

The substance next in order is one of great interest in many respects—chemically, mineralogically, geologically, and, I might add, metallurgically. It is the mineral known as felspar, of which there are several varieties, or distinct species rather; but the felspar to which I shall call your attention is the one known as orthoclase, or potash felspar, in distinction from periclase, or soda felspar. Then we have some containing a very large quantity of lime. This potash felspar consists essentially of silica, potash, and alumina. It has this formula, taking the old one proposed by Berzelius—$KOSiO_3 + Al_2O_33SiO_3$. You see I am maintaining the old notation; some fight stoutly for one, and some fight manfully for the other. Potash felspar is analogous in point of constitution with potash alum. If we replace the silica by sulphuric acid, we get alum.

Felspar exists very extensively diffused throughout the world, and plays a very important part. It is, no doubt, the source of our clays. Perhaps all the clays which we meet with in the world are derived from the decomposition of felspar, or some closely analogous compound. Of that I have little doubt.

What proof have we of the conditions under which felspar has been formed? Well, I think I can present you with some very satisfactory evidence on this subject. A good many years ago, on pulling down some old copper furnaces in the province of Mansfeld in Prussia, where copper smelting had been carried on for many centuries, some beautiful crystals were discovered, many of which had a delicate tint. Their form was exceedingly sharp and well defined, and sometimes they occurred of considerable dimensions. I am fortunate in being able to present you with three specimens of this felspar. I believe search has been often made for it since, but without success. It was found in the lower part of the furnace, especially in the hearth. It was found, also, not only in crystals, but also massive, and intermingled with some black matter. It contained sulphide of zinc and carbonaceous matter as well. Here is a sample of this black matter; and here is a specimen of felspar in numerous crystals coating this piece of rock. These crystals are identical, crystallographically and chemically, with potash felspar. Several analyses have been made of them by different and very competent observers with the same result. You shall have one analysis, from which you will be able to judge for yourselves of its composition. It contains a little foreign matter in addition to its combined elements, but this takes no part in the constitution of the formula. We very often find, as I said on a former occasion, this accidental presence of foreign matter which has nothing whatever to do with the chemical constitution of the body. Here are the results of an actual analysis:—

	Per cent.
Silica	64·53
Alumina	19·2
Peroxide of iron	1·2
Lime	1·33
Copper	0·27
Potash	13·47

The lime present is quite insignificant in quantity. The presence of a little copper need not surprise us, because these crystals were formed in a copper furnace. We shall ascertain, by calculating the composition of this formula, that really these two bodies, the natural and the artificial, are chemically identical.

I do not know that we have met with any other instance of the artificial formation of felspar in this way—that is, by igneous action alone. Here, unmistakably, these crystals have resulted solely from the operation of fire. We see, then, the possibility of the so-called plutonic formation of this mineral. On the other hand, it is equally certain that this mineral has been produced by what I have called hydrothermic action—that is, by the action of water at a high temperature and under considerable pressure. Daubrée, an observer on whose authority we may rely with confidence, and whose name I have often mentioned, produced felspar by acting upon obsidian, that black volcanic glass, by water at a high temperature. The obsidian was changed into a greyish matter, having still the same chemical characters, but by the naked eye it was seen to be crystalline, like a fine-grained trachyte. We shall speak of trachyte hereafter when we come to consider the subject of volcanic action. This substance, examined by the microscope, showed clearly the characters of felspar—that variety known as glassy felspar or rhyacolite. There is positive proof, then, of the formation of felspar by aqueous agency. He also produced it by heating kaolin in a glass tube with the water of a particular mineral spring containing alkalies—the water of Plombières; but I must defer the details of the process till we come to discuss the action of this water in the formation of minerals. There is no doubt that felspar was so generated. There can be no doubt, however, that granite, in which it occurs, and which we meet with all over the world, has been the result of mere fusion, as it is called. It is remarkable to me that it should be so produced, especially when we remember the difference of specific gravity between the fused and the crystallised quartz. The hydrothermic theory of its formation has many warm supporters, and one of the warmest and most able is undoubtedly Bischoff.

We now come to mica. I can tell you very little of this body. I know very little of it of my own knowledge—of its formation by artificial means; but there are one or two facts concerning it which must be laid before you. Mitscherlich found it in an old slag heap in Sweden. Hausmann is said to have found it in the cavities in the hearth of a furnace, in sandstone. Daubrée tells us that he formed uniaxial mica in hexagonal scales from clay in superheated water containing dissolved silicates. I need not enter into its properties. It is now very well known, and extensively employed in the arts. It has the curious property of splitting into thin leaves. There are many kinds of mica. Here is a specimen which I received, since I gave the last course of lectures, from Sir Charles Lyell. He found it among the specimens of the late Mr. Horner, and Mr. Horner received it from Mitscherlich direct, and it is said to have been formed by Mitscherlich. The formula of mica is this:—$3RO2SiO_3 + 2(R_2O_3)SiO_3$. You see this really seems to be wollastonite again combined with silicate of alumina, and thus forming mica. I do not say that the first part of the compound really is wollastonite; but it has the same formula. Wollastonite is, you know, a silicate of lime; but the RO is composed of

various bases, not of one alone. It is very desirable to get further information concerning the conditions under which mica may be formed.

I will mention incidentally another mineral. It is one of no great importance geologically, as far as I know; still it has certain features of interest commercially and in other respects. I refer to that remarkable substance known as ultramarine, about which so much has been written, and concerning which so many experiments have been made, but unhappily with very little that is satisfactory with regard to positive information. Here is a specimen of ultramarine. It is a fine blue mineral substance, very highly appreciated, especially by the ancients, as a decorating stone. It is essentially a silicate of alumina and soda. Well, what about the colouring matter? Chemists are by no means agreed as to the cause of the blue coloration. Some suppose it depends upon a sulphide of iron in some particular state. There is a sulphide doubtless which is connected with the colouring matter, but the sulphide is only in very small quantity, for we can discharge the colour of this ultramarine immediately by the action of an acid. Take, for example, common ultramarine. Here it is in this glass vessel, suspended in water. We will add to it some hydrochloric acid; the whole of the colour will be gradually discharged, and there will be evolved the odour of sulphuretted hydrogen gas. That is invariably present in all specimens of ultramarine, so far as my knowledge goes. The colour will not disappear immediately, unless we put in a considerable quantity of the acid, but it is sure to go in the long run. It is now getting paler and paler. I will give you a common illustration of this. Formerly all the blue paper which we produced—common blue writing-paper, for instance—was coloured with a pigment having oxide of cobalt as its base—smalts, in fact. Now, if you acted upon such a paper with an acid, there was no discoloration. The blue colour remained. But owing to the artificial production of ultramarine it was found economical to replace the natural smalts by the artificial ultramarine in the manufacture of the paper, and now you will find that by dropping an acid on such paper the colour is discharged, but that is not the case with the natural mineral previously used. Smalts is still used to colour starch. Starch-makers have tried to substitute the artificial ultramarine, but in vain.

Ultramarine occurs naturally as lapis lazuli, and it is associated with iron pyrites. The iron pyrites is not visible to the naked eye, but under a microscope it is quite distinct. I think you will find that all lapis lazuli is associated with iron pyrites. This suggested the possibility, at all events, of iron being concerned in the production of the colour of this mineral. It is now a good many years since the mode of the formation of ultramarine was discovered. In a soda furnace a beautiful blue-coloured substance was met with, and this turned out to be ultramarine—identical with the natural substance. It is easily made, but of course there are certain points in the manipulation which require experience. I worked months at it, and made a considerable quantity. We have only to take sulphur, china clay, and carbonate of soda, put them in a crucible and cover them over, and then leave them at a good red heat for three or four hours. You will be somewhat astonished to see, on taking out the crucible, a magnificent blue colour. Below it will be green. You wash out the sulphur, and there remains behind a dull green product—green ultramarine. Then by roasting that, with access of air under certain precautions, you can convert that into a very fine blue. There are certain points of manipulation in the process which are kept secret by the manufacturers—the heating it with sulphur, and so on, but there is, I believe, no difficulty in making it if you have a furnace. This gives us proof, then, that ultramarine may be formed under these conditions of temperature, say a good red heat, but whether the ultramarine in nature has been so produced I should regard as doubtful. That is a point requiring further investigation. Possibly, here again we may have to do with hydrothermic action.

The artificial ultramarine is a very cheap thing, worth about eightpence a pound; the other is worth several guineas an ounce. I say they are *chemically* identical, but though they are chemically identical they are not physically the same. The natural is much better than the artificial for many purposes, and has a better colour. I will give you a striking example of this fact. It was related to me by a Royal Academician some years ago. On one occasion, the day before opening the Academy to the public, when the artists who are exhibiting generally attend and touch up their pictures, one of our greatest landscape painters, who was in the habit of doing a great deal to his pictures, was present, and on this particular occasion he wanted some ultramarine. He was looking about among his fellow-artists for some of the real ultramarine, and there happened to be another landscape painter present who had his palette beautifully set with a fine lump of the natural article. The painter was about to help himself from his friend's palette, whereupon the other artist called out "French," alluding to the artificial product, on hearing which the painter immediately withdrew. This shows you that the artists, at all events, recognise a great difference of quality between the real and the artificial stuff. That anecdote might be related in the history of one of the greatest landscape painters who ever lived. I believe it has never been recorded.

Having said thus much of the formation of certain natural anhydrous silicates, we will pass on to review the hydrated silicates, or the silicates containing water as an essential element of their composition. We can make hydrated silicates without difficulty. You have before you a pretty extensive series of these silicates. Here is one—a silicate of chromium. This [another specimen] is a silicate of copper powdered; and there is one of manganese, and there is one of lead, and here is one of cobalt. They are made easily enough by taking silicate of soda (water-glass), diluted to a certain extent with water, and then adding it to various metallic salts—say chloride of copper, if you please, or of nickel, or of cobalt. The water-glass should be perfectly pure and colourless. Here is a salt of cobalt; now to that we will add some silicate of soda, and there will go down a precipitate which will consist of silica combined with oxide of cobalt and water—a hydrated silicate of cobalt. The same with nickel. Here, again, is a silicate of copper produced in this way. Here is silicate of lead, a firm jelly-like mass.

Here is a silicate which really is interesting, and to which I will invite your special attention. It is the silicate of copper. This is some made about a year ago by throwing down copper from a copper salt—chloride, I believe it was—by means of this silicate of soda. It went down in the form of this greenish precipitate, which was collected on a filter, washed, and dried. If you examine it, you will see how much it resembles the well-known mineral called chrysocol. Here is a silicate of iron, and in this case there are two oxides combined. It is a silicate of two oxides. We find the same thing in that green Cleveland iron ore. As far as we can make out, we have a silicate of protoxide and peroxide of iron in this compound; but what the exact relation of the two constituents is we cannot say. Now, the colour here will suggest the colour of the green earth, or rather of the substance which you find in the green sand. It is a silicate produced artificially by the addition of silicate of soda to a salt of iron.

These hydrated silicates occur abundantly in nature. They are amongst the most beautiful minerals we see in mineralogical cabinets. The various zeolites, for example, are hydrated silicates. They only require to be seen and examined to be thoroughly appreciated. They lose their water when strongly heated (that you might expect); yet there is a singular point which may be mentioned here in

connexion with this statement—namely, that Bunsen has shown us how a hydrated crystallised silicate may be produced even at a good red heat. If you take a finely powdered mixture of about two-tenths by weight of lime and one part of silica, and drop the mixture into molten caustic potash in a golden crucible (that is the best kind of crucible to use), and keep it at a strong red heat for some time, and then allow it to cool slowly, and afterwards treat the solid mass with cold water, the excess of potash will be dissolved out, and there will remain a beautiful crystallised apparently zeolitic mineral; it is a hydrated silicate of lime—one containing water, but the proportion of water is not determined. In fact, in other respects it has the same composition as wollastonite combined with a not yet definitely known proportion of water. It is impossible to make this experiment on a large scale. Here is some so prepared, but it has become opaque by exposure to the air. The oxide of potassium, when combined with water, retains that water at a red heat, and this is a condition of the formation of this hydrated silicate at this high temperature. You may ask, "How do you know whether this silicate has not become hydrated by the action of the water on the mass in washing out the potash?" Well, that is a question to be settled. I think it is not so: I think the evidence is in favour of the other view; but still it is a fair question to raise.

These hydrated silicates occur specially in the cavities or fissures in igneous rocks, as in the basalt in the north of Ireland. In those rocks there are cavities lined with these beautiful zeolitic minerals, but they occur not only in igneous rocks, but also in sedimentary beds. Then we find stilbite and apophyllite in certain fresh-water limestones, and also in fossiliferous limestones in Scotland.

Some hydrated silicates are decomposed, and decomposed pretty rapidly, by exposure to the air. Some, on the contrary, are quite permanent. One of the best examples—and one familiar to every mineralogist—of decomposition on exposure to the air, is presented by laumonite, which is a hydrated silicate containing especially soda. It consists of soda, lime, and alumina, in combination with silica and water. It decomposes pretty rapidly on exposure to the air. But even those silicates which appear the most persistent are slowly decomposed by exposure to the air. Take common glass, for instance, of which I showed you a specimen acted upon by the weather. Even that substance, permanent as it seems, becomes decomposed on very long exposure to atmospheric influences. Illustrations of this fact may be seen in the Museum above. Take, again, the well-known mineral felspar, which occurs in granite. In some granite the felspar rapidly decomposes through the weathering action of the air, and is converted into china clay, a mineral which is well known and of great importance in the manufactures of Cornwall and elsewhere. Hydrated silicates resist the action of cold water for a long time. This is seen in the case of an ordinary bottle. But under other conditions of temperature the result is different. If you take a common wine-bottle, for example, and expose it to the action of water at a very high temperature and under great pressure, it becomes entirely disintegrated—I was going to say dissolved. What takes place with these artificial silicates would take place with the natural silicates when exposed to water at a high temperature.

In nature these zeolites, or hydrated silicates, have undoubtedly been formed in many cases by the percolating action of water or steam. Water or steam separately, or water and steam conjointly, have percolated during, it may be, a very long period through cellular volcanic rocks—igneous rocks containing cavities in them—and hydrated silicates, or zeolites, have been formed by the action of the water and steam separately or conjointly upon the constituents of these rocks, and we accordingly find the cavities filled with beautiful zeolites. The basalt of the Giant's Causeway presents us with many specimens of zeolites formed in this way. There is a very good name suggested by Bunsen, I think, for this gaseous action. He proposes to call it "Pneumatolitic action." No doubt gas or steam has played a very important part in the structure of the globe. Bunsen has made observations on this point in Iceland.

Now, ladies and gentlemen, I have to bring before you illustrations of the formation of zeolites in this way. We owe the information to Daubrée, who has written a capital paper on the subject in the *Annales des Mines*. Daubrée has presented specimens to my colleague, Professor Ramsay, who, unfortunately, is out of town, and I am unable to lay my hand on them. At Plombières, the well-known French watering-place, there are well-known hot springs which have been flowing for thousands and thousands of years, certainly two thousand years or more. We find there the remains of Roman works constructed with a view to carry off the water of these hot springs; and under the pavement of the streets, at a great depth, are aqueducts, the object of which was to intercept the water and convey it to reservoirs. Where the waters emerge, the Romans made a bed of concrete with lime—lime not mixed with sand, but mixed with fragments of brick and sandstone. The Roman mortar, you will find, almost always presents small particles of brick. I have of late several times examined the mortar in the outer walls of Pepin's Castle, and there is a very good illustration of this. You will find thick tiles, and then mortar, and then stone; and, on examining the mortar used there, you will find throughout small particles of brick disseminated. It may be that the clay was actually burnt and used as such—this is sometimes done in the manufacture of fire-bricks and fire-clay, instruments of various kinds—or it might have been pounded. Now, this channel or bed of concrete, at Plombières, extends more than ninety metres in length, and in some places it is not less than three metres in depth. The beds rest, here and there, directly upon the granite of that district; but in general it is separated from the granite by an alluvial gravel. By the long-continued action of these thermal waters upon this bed of concrete, remarkable changes have taken place, and zeolites—unmistakable zeolites, having the same composition as the natural minerals, and the same crystalline form—together with certain other minerals, have been produced. They are found especially in cavities in the mass, as you would expect, and they form in these cavities mammellated, more or less rounded concretions, and are sometimes more or less crystallised. In the granite, which was subject to the same conditions as the brick and mortar, no zeolites were detected. Here, then, you see, we can examine the results of an experiment which has been going on uninterruptedly for about 2000 years—a very short time in a geological sense, yet during this time we find that well-defined, distinct crystals of zeolites have been produced.

One of the zeolites resulting from the action of this thermal water is apophyllite, that magnificent mineral which constitutes a special ornament of geological cabinets, and which crystallises in the pyramidal system. This apophyllite may be represented by the formula of 3 equivalents of wollastonite *plus* 2 equivalents of water—$3(RO2SiO_3+2HO$. But, different from wollastonite, this base, RO, in apophyllite, consists of lime and potash—that is, CaO and KO—and they are in the ratio of 1 to 8 equivalents, 1 of lime and 8 of potash. We find fluor mentioned as a constituent in many analyses of apophyllite. Daubrée found apophyllite lining the cavities of the calcareous part of this bed of concrete. The thermal waters at Plombières contain an alkaline silicate. It appears to be by the long-continued action of this alkaline silicate upon the lime of this bed of concrete, during many centuries, that the apophyllite has been formed. You see that in this body there is the silica, there is the alkali, and there is the lime, while in the Plombières

water there are the silica and the alkali, and in the concrete there is the lime.. We get well-shaped, unmistakable crystals of apophyllite. They may not be so large as those which nature presents; but then, remember, the time during which they have been forming—two thousand years—is a comparatively short period. Nature, in the formation of the native mineral, may have taken twenty thousand years. Once let us have a clue to the conditions under which these crystals have been formed, and then *give us time*, and we can make them of any imaginable size. Native apophyllite is usually met with in veins in amygdaloidal rocks, in cavities and veins in transition slate, and in basalt.

The next mineral which Daubrée met with in the bed of concrete was chabasite, which is also a well-known mineral in our geological cabinets. Here, again, in representing its constitution, we begin with $3RO_2SiO_3$, which represents the first part of the formula of chabasite. Then we have *plus* $3(Al_2O_32SiO_3)$ *plus* 18 equivalents of water.

$$3RO_2SiO_3 + (Al_2O_32SiO_3) + 18HO.$$

The RO here represents three bases—lime, soda, and potash. In many cases there are blisters in the bricks, which are filled with chabasite. The crystals are colourless and perfectly limpid, rhombohedral and approximating to the cube. They were feebly striated and parallel at the edges, like the natural crystals, and occasionally presenting the macle which we find in the natural specimen. In its chemical characters and crystalline form the artificial chabasite was found to be identical with the natural mineral. Chabasite occurs in nature in cavities and veins in amygdaloidal rocks—this, again, being a place where percolation may have been at work.

Daubrée, in addition to these well-known hydrated silicates, found certain other hydrated silicates or zeolitic minerals, but he has not—or at all events when he wrote his paper two or three years ago he had not—certainly proved their identity with the native species, from the impossibility of getting them pure enough and in sufficient quantity for exact analysis. The chabasite crystals he met with were often studded over with microscopic crystals resembling in all respects a variety of gismondine, more rarely with crystals like those of scolezite, and with a few prisms like harmatome—one of the finest minerals in geological cabinets. You will find here very beautiful specimens of all these minerals.

The thickness of the zeolitic incrustations on the concrete was not less than one twenty-fifth of an inch. That is a tolerably good thickness. In cavities at the lower part of the bed of masonry, and near the point which received a direct jet of hot water, were found tolerably copious, gelatinous, transparent, and colourless deposits, which on drying in the air became opaque, snow-white, and mammellated — presenting this sort of form ⌒⌒⌒. The chalcedony, you remember, was mammellated—in round masses. A surface of that kind is called mammellated, in mineralogical language. Their construction was concentric. They were in concentric layers, and fibrous in fracture, like chalcedony, malachite, and brown hæmatite. We find those minerals presenting just the same characters of structure as those particular deposits met with at Plombières by Daubrée. This substance gelatinises with acids, showing the separation of silica, which had existed in a state of combination. The composition was supposed to be a silicate of lime—a trisilicate of lime, or a neutral one, it would be according to one view, there being one equivalent of lime and one of silica—that is, a silicate in which the oxygen of the acid is exactly three times as much as that of the base. There were also exactly two equivalents of water.

Well, along with these minerals he found also another, which we examined in our first lecture, and which you will no doubt remember—namely, hyalite, a beautiful variety of amorphous silica. This could not be distinguished, he says, from the hyalite met with in basalts, of which you saw specimens. He found also common opal, grey and resinous in lustre. He met, too, with arragonite and calc spar associated with chabasite, as in the volcanic rocks of Iceland. Fluor spar was also detected, white, and occasionally of a violet tint, just like that we meet with under the name of "blue John," and often in the vicinity of apophyllite. Now, that is a point worthy of notice. I said, when speaking of apophyllite, that many analyses would be found to mention fluor spar. This suggests in a very striking way that in nature, in all probability, the apophyllite we meet with may have been formed under exactly similar conditions—namely, by the long-continued percolating action of water containing, it may be, an alkaline silicate and fluor, upon certain rocks containing lime. He found also a hydrated carbonate of magnesia which he believed to be a new species. Nothing more, I think, has been done with that. Fluorine, as I said, is a very widely diffused element, though not diffused in large quantity. These zeolites do not occur exceptionally, but in every part of the concrete traversed by the thermal waters.

Now, I think you will agree with me that the fact of the identity of these zeolites, not only in physical but in chemical characters, with those occurring in nature suggests naturally an identity of conditions for their formation. I do not mean to say that it is absolute proof, but it is next to it. I can scarcely conceive of any proof more strong than this in geological reasoning. We do not want here the action of water at very high temperatures. We find that by the action simply of this thermal water flowing for a long period of time we generate these minerals. I do not mean to say that possibly, if we had employed a somewhat higher temperature, they might not have been produced at a more rapid rate; but it is a mere assumption that it would be so, and we have no proof of it. We do not, however, require a very high temperature here, and certainly not a very high pressure. I do not suppose that increased pressure has played any part in the production of these minerals in the thermal spring. When we want to attain a high temperature with water, we must have a high pressure, or we cannot get the temperature; but it is not the pressure that does the work. We must not make that mistake of confounding the *post hoc* with the *propter hoc*. Wöhler dissolved and crystallised apophyllite in water at a temperature of 180° Centigrade, under a pressure of ten atmospheres; but in the waters of Plombières the same mineral was produced and crystallised after a length of time without any such pressure. Daubrée remarks that, notwithstanding the extreme hardness of the Roman masonry, it was yet pervious to the thermal waters, by cavities, by fissures, by the substance of the mortar itself being porous, and especially by the innumerable blistera (*boursoufflures*) produced in the bricks by burning. The current of water was very small; but it was constantly renewed, and thus we find that means of a very feeble nature become multiplied immensely by the action of time. In fact, it is a question of time, not only in this matter, but throughout the whole range of geological research.

Now, it is singular, and it must strike you all as singular, that such distinct minerals should be formed close to one another under conditions so apparently similar, if not identical—formed from the same matter, by the same agency, in the same thermal water. As Daubrée says (these are his own words)—"If it were not for the difference of colour it, would even be very possible to confound parts of the concrete charged with zeolites with basaltic tufas in which the same minerals have been formed. The bricks, with their blisters and their drusy cavities, imitate, in a remarkable manner, amygdaloidal rocks." Then he says: "Such an identity in results reveals incontestably great analogies in origin." Another experiment which bears upon their origin is one of high interest—namely, the transformation of common glass into a zeolite by the

action of superheated water—hydrothermic action. Here, again, we must acknowledge our obligation to Daubrée, who has done so much in this department of observation.

If glass (silicate of lime) be acted upon by water at 200° Centigrade, the product is a hydrated silicate containing some of the alkali. The form is preserved, but the glass itself is increased in volume. There is a swelling up of the glass to the extent of about one-third, and it becomes opaque and snow-white, very decidedly fibrous in structure, easily fusible, and completely decomposed by acids when cold. Here you see a marked difference. The composition of it was determined after washing with boiling water and drying at 100° Centigrade. It was found to be analogous to the mineral called pectolite, which occurs in spheroidal masses composed of delicate fibres radiated from the centre. It is found with mesolite in amygdaloidal rocks. The composition of this product was:—

Silica	61·8 per cent.
Lime	21·9 „
Magnesia	3·9 „
Soda	6·3 „
Water	4·2 „
Alumina	*simply traces.*

This, understand, was the result of the action of water at 200° Centigrade upon glass. Now for the action of water at a higher temperature upon the same kind of glass. At 400° Daubrée obtained crystallised quartz and wollastonite in acicular crystals. This I conceive to be very important, as showing us that different products may result from the action even of pure water at different temperatures upon the same rock. I repeat this—it is important as showing that different products may result from the action even of pure water at different temperatures upon the same rock.

The next substance for our examination is one to which I have incidentally referred. I shall not have time to finish it entirely to-day, but I will just begin it. It is one of considerable interest in various respects—the substance clay.

There is reason to believe that clay is nothing more than the result of the decomposition of felspar, or a somewhat analogous rock. It is a secondary product in every case. We can show you how this clay is produced step by step from the felspar occurring in certain kinds of granite. We can present you with specimens of granite in every stage of weathering. We can show you the perfect mineral, and you can trace the formation of the china clay, which is a silicate of alumina, with certainty, leaving no doubt of the conditions under which this clay has been generated. There is reason to believe that all clay has been produced, I will not say from felspar, but from some analogous rocks. All clays contain, without exception, alkali. I say this without fear of contradiction. Although decomposition takes place through weathering action, the alkali is never perfectly washed out. We have made a very large number of analyses of different kinds of clay at different times, and when we have sought for alkali we have never failed to detect it—potash and soda. Now, if you refer to books giving analyses of clays, I know that often you will find no mention whatever of alkali; but this omission is to be ascribed to the fact of the alkali not being sought after. To determine the alkali requires a separate process, and a very tedious one; and unless there is some special object in finding it, the chemist will not give himself the trouble of searching for it. We will proceed with the subject of clay in the next Lecture.

ACADEMY OF SCIENCES.

July 16.

M. Marignac presented an account of some "*Researches on the Combinations of Tantalum.*" The author's researches have had for one object the more correct determination of the atomic weight of tantalum. This, Rose, from the analysis of the chloride ($TaCl_5$), has given as 172 (H = 1, O = 16), but M. Marignac is of opinion that the chloride analysed by Rose had a considerable admixture of niobium. M. Marignac has analysed the fluotantalates of potash and soda, and has arrived at the corrected number 182 as the atomic weight of tantalum. He points out that the atomic weight of niobium is very nearly the half of that of tantalum, Ni = 94 Ta = 182, and remarks a strict parallelism in the compounds of these two metals. Tantalic acid, the formula of which is given Ta_2O_5, the author states, is found in two distinct modifications analogous to those of stannic and antimonic acids.

MM. Landenburg and Leverkus presented a note "*On the Constitution of Anethol.*" Anethol is the essential principle in oil of aniseed. It is a crystalline body, distilling without decomposition at 234°. Its composition answers to the empirical formula $C_{10}H_{12}O$. The author, however, has satisfied himself that anethol is the methylic ether of allylphenol, and so writes the rational formula thus—

$$C_6H_4 \left\{ \begin{matrix} OCH_3 \\ C_3H_5. \end{matrix} \right.$$

MM. G. de Laire, Ch. Girard, and P. Chapotesut presented a note "*On the Formation of Secondary Monamines of the Phenylic and Tolulyic Series.*" The authors have formed *diphenylamine* by the reaction of aniline on a salt of the same base—the hydrochlorate answered best In a similar manner they have formed *ditoluylamine*. *Phenyltoluylamine* was formed by the reaction of aniline on hydrochlorate of toluidine. The reactions are effected most quickly in sealed tubes, but will take place in a convenient distilling apparatus. In all the reactions ammonia was eliminated, and the changes that took place are indicated in the following equation, which accounts for the production of diphenylamine:—

$$\left.\begin{matrix} C_{12}H_5 \\ H \\ H \end{matrix}\right\} N + \left.\begin{matrix} C_{12}H_5 \\ H \\ H \end{matrix}\right\} N = \left.\begin{matrix} C_{12}H_5 \\ C_{12}H_5 \\ H \end{matrix}\right\} N + \left.\begin{matrix} H \\ H \\ H \end{matrix}\right\} N.$$

We shall give a fuller description of the process next week.

M. Lecoq de Boisbaudran sent a note of no interest "*On Supersaturated Solutions.*"

M. Zaliwski-Mikorski sent a note "*On the Disaggregation of Metallic Carbon,*" which, it seems, may be effected in a Bunsen's battery by using, instead of zinc, iron rendered passive by nitric acid. Fuming nitric acid and a little sulphuric is placed in the porous cell; the external cell is filled with water. As soon as the battery is in action, the carbon begins to disintegrate, and continues to do so as long as the iron is passive.

At the previous sitting of the Academy, M. Chevreul gave an account of some experiments illustrating what he calls *capillary affinity*. He made a paste of white lead and water and another of white lead and linseed-oil, and placed them in separate tubes. Above the oily paste he placed water, and above the watery paste, oil. The oil in the latter case displaced the water, but water did not displace the oil in the former. In corresponding experiments with clay and pure kaolin it was found that water would in each case drive out oil, but oil would not drive out water.

Concretions in Pears.—Erdmann has examined the hard granular concretions in pears, and found them to be composed of a distinct principle to which he has given the name *glyco-drupose* $C_{48}H_{36}O_{32}$. Under the influence of an acid this body splits up into glucose and an insoluble body $C_{21}H_{20}O_{16}$, which the author calls *drupose*. We may mention, for the information of our medical readers, that the author was led to the research by the examination of a mass of these concretions passed from the bowels of a patient which was regarded as a pathological product.—*Annal. der Chem. und Pharm.*, cxxviii., p. 1.

NOTICES OF BOOKS.

Zeitschrift für analytische Chemie. Parts iii. and iv. 1865.

(*Continued from page* 34.)

The next paper we may mention is by Dr. O. Lindt, "*On the Estimation of Sulphur in its Metallic Combinations in the Presence of Sulphuric Acid.*" The process is a slight modification of Rose's for the determination of sulphur in metallic sulphides. Rose passes chlorine over the sulphide and carries the chloride of sulphur into a vessel of water, where it decomposes, free sulphur separating and some being eventually converted into sulphuric acid. Dr. Lindt says it is better to carry the chloride of sulphur into a soda solution, where it first forms sulphide of sodium, hyposulphite of soda, chloride of sodium, and hypochlorite of soda. By continuing the action of chlorine for two hours chlorate of soda is formed, and now, on evaporating the solution and igniting the residue, the whole of the sulphur compounds are converted into sulphate of soda, in which the amount of sulphur is easily determined. A drawing of the apparatus the author recommends is given, but we doubt whether it offers many advantages over the ordinary arrangement with a simple flask.

The next paper is one, by Dr. Remelé, we have mentioned before, "*On the Estimation and Separation of Oxide of Uranium by the Use of Sulphide of Ammonium.*" We shall give an abstract of this paper on a future occasion.

The last original paper is "*On the Recognition of Alkaloids,*" by Rudolf Wagner. Suppose we have a solution rich in extractive matter, and containing a small amount of strychnine, brucine, morphine, codeine, quinine, &c.—say a litre of beer with from 0·002 to 0·004 grm. of strychnine in solution—the author recommends the following mode of proceeding:—Dilute the beer with twice its weight of water, and then add 5 c. c. of a solution of iodine in iodide of potassium (12·7 grms. of iodine in a litre). When the solution becomes clear pour it off from the deposit (the formation of this deposit will be hastened by acidulating with sulphuric acid), and dissolve the precipitate in a dilute solution of dithionite of soda; then filter the solution and again add the iodine solution, and this time dissolve the precipitate in an excess of sulphurous acid. In this solution, when freed from hydriodic and sulphurous acids by evaporation, the bases will be found as sulphates quite free from organic matter, to be recognised by the usual tests.

The rest of the Journal is occupied with the usual "*Reviews of the Progress of Analytical Chemistry,*" by Forster, Fresenius, Neubauer, and Braun. The titles of the papers noticed in these reviews would occupy a column of the Chemical News, and it is necessary to say that the greater number have already appeared or been noticed in our pages. Such others as present any novelty and interest will be transferred to our columns.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

1737. S. Holmes, Lincoln's Inn Fields Chambers, Middlesex, "Improvements in the manufacture of printing ink."—June 29, 1866.

Notices to Proceed.

934. E. P. H. Vaughan, Chancery Lane, "Improvements in the methods of solidifying the juice or sap of the bullet tree, otherwise known as Balata juice, and the juices or saps of trees yielding similar or analogous elastic products," A communication from S. R. Pontifex, F.C.S., Demerara, British Guiana.—April 2, 1866.

CORRESPONDENCE.

A Ridiculous Patent.

To the Editor of the Chemical News.

Sir,—Referring to your complaint in your number of July 6 about the strange things which appear, not unfrequently, as inventions protected by letters patent, or at least by a provisional protection, I beg to draw your attention to the specification of Mr. J. Roddy—"An improved washing or cleansing liquor or solution," dated October 7, 1865. To save you the trouble of looking yourself for it, I beg to subjoin the following abstract from the *Mechanics' Magazine* of May 4:—

"In performing this invention (!) the inventor takes by weight two parts of crystals of soda and one part of unslaked lime, and adds thereto twelve and a half parts of water, preferably boiling water. This crude liquor he allows to stand until all the insoluble matter has been precipitated, when he pours off or collects the clear fluid. This fluid is the improved washing or cleansing liquor or solution."

Is it not a pity on one side, but an incalculable gain to manufacturers—nay, to all humanity—on the other side, that the patent on this grand "invention" has been abandoned? I am, &c., G. Z.

July 21, 1866.

MISCELLANEOUS.

Exhibition of Objects relating to Pharmacy at Nottingham.—We must remind intending exhibitors that immediate application for space must be made to Mr. J. H. Atherton, Long Row, Nottingham, as only limited accommodation is left.

Preparation of Nitrite of Potash.—In a note to his paper on the nitrous acid compounds of cobalt and nickel, Erdmann gives the following process for the preparation of nitrite of potash. He recommends the fusion of the nitrate with several times its weight of iron filings or borings in a cast-iron crucible at a carefully regulated red heat. When a small portion taken from the crucible and tested shows a strong evolution of nitrous acid, the mass is poured from the crucible. When cold the mass is dissolved, and then the undecomposed nitrate is removed by crystallisation; the liquor is then supersaturated with nitrous acid from starch and nitric acid, and afterwards evaporated to dryness at a gentle heat.—*Journ. für prakt. Chem.*, No. 7, 1866, p. 387.

Amount of Sulphuric Acid obtainable from Pyrites.—An obliging correspondent, W. H. D., forwards the following calculation, which we publish at length, as an example. "Sulphuric acid from 20 cwts. of ore containing 30 per cent. of sulphur. Sp. gr. of acid 1·75.

Theoretical quantity.

100 cwts. of ore contain 30 cwts. of sulphur

20 " " ·6 "

$S\ 32, O_4, 94\ H_2\ 2 = 98$

32 : 98 :: 6 : 18·38 cwts. of H_2SO_4.

Sp. gr. (Ure)	Sp. gr. (Ure)
1·754 = 84 % of H_2SO_4	1·7425 = 83 % of H_2SO_4
$\frac{100 \times 18{\cdot}38}{84}$ 21·89 cwts. acid	$\frac{100 \times 18{\cdot}38}{83}$ 22·18 cwts. acid

Our correspondent also gives calculations based on the tables of Bineau and Otto given in Fresenius; but those we have quoted will suffice.

ANSWERS TO CORRESPONDENTS.

Books Received.—Bleeding and Change in Type of Disease, by W. O. Markham, M.D., F.R.C.P.; Buckmaster's Elements of Chemistry, third edition; On Cholera, its Nature and Treatment, edited by Dr. G. Drysdale (pamphlet).

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THE

CHEMICAL NEWS

AND

Journal of Physical Science.

Edited by] *[Wm. Crookes, F.R.S.*

No. 348.] *Registered for* Friday, August 3, 1866. *Transmission abroad.* {PRICE 4*d*. / POST FREE, 5*d*.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

New Analysis of the Montpellier Saline Chalybeate (Kissingen) Water at Harrogate, by Dr. Sheridan Muspratt, *M.D. (Hon.), Ph.D., F.R.S. Ed., M.R.I.A., &c.*

Some very extraordinary changes seem to be occurring in the waters of Harrogate. Since they were so elaborately investigated by my valued friend Dr. A. W. Hofmann in 1854, chloride of iron* FeCl has made its appearance in one of them (discovered by me in July, 1865), and salts of barium, strontium, lithium, &c., in others. Sulphates have nearly disappeared from all. In the Kissingen water Dr. Hofmann found nearly forty-two grains of carbonate of magnesia and *no carbonate of lime.* Now it contains about half a grain of the former and sixteen of the latter! Appended are the numbers just obtained :—

	Grains in the Imperial gallon.
Carbonate of iron	3·106
Carbonate of baryta	·517
Carbonate of lime	16·262
Carbonate of magnesia	·497
Chloride of calcium	124·112
Chloride of magnesium	56·074
Chloride of potassium	5·408
Chloride of sodium	650·409
Strontium, lithium, &c.	traces.
	856·385

I am engaged with several other of the waters, and hope shortly to furnish you the results. In the Chemical News of June 29 it is said that the Kissingen water contains 7·657 grains of *carbonate of baryta* in the gallon, apparently a most erroneous statement.

On Certain Reasons for Doubling or otherwise Multiplying Chemical Formulæ, by John A. R. Newlands, *F.C.S. (Second Paper.)*

Dr. Stevenson, in criticising my paper on the above subject, says that my "first argument, drawn from the doctrine of chances, does not state anything more than a truism," yet in that first argument I observed that "the statement that the hydrochloric acid molecule contains only one atom of hydrogen and one of chlorine is a mere assertion; it is only one possibility out of millions of possibilities, and consequently there are millions of chances to one that it is wrong." Now, after admitting this to contain nothing more than a truism, or self-evident proposition, Dr. Stevenson still clings to the doctrine that the hydrochloric molecule contains only one atom of hydrogen to one of chlorine, he still believes that this one possibility out of millions of possibilities is quite correct; at any rate, he states "that the presumption is in favour of the simpler formulæ." But, I would ask, why so? If we look solely and singly to conclusions drawn from the doctrine of probabilities, the lowest, or simplest, number has no greater chance of being correct than any above it. If, for example, there were fifty thousand tickets in a lottery, I do not see any reason for thinking, or even "presuming," that the ticket bearing the lowest or simplest number stands a better chance of winning the principal prize than any above it. In the same way I do not understand how any one admitting "the molecule of hydrochloric acid to contain $Hx Clx$, the value of x being uniform," should, from considerations drawn from the doctrine of probabilities, state "that the presumption is in favour of the simpler formulæ"—that is, of x being one instead of any other sum from one to infinity.

Upon this point it would be well to bear in mind the opinion of Dr. Hofmann, who observes, in his late work, that "the smallest quantity in which hydrogen combines may, for aught we know to the contrary, be a cluster numbering ten, or a hundred, or a thousand, or a million, of really ultimate atoms." Perhaps Dr. Stevenson considers this a truism—at least he appears to possess information upon a subject on which one of the most illustrious of our modern chemists has not hesitated to plead his ignorance.

Dr. Stevenson says that my "second argument, drawn from geometrical considerations, is at variance with my third, drawn from the nature of elementary molecules;" and he very properly observes that if four is the least number of atoms that can form a molecule, that of mercury must be represented by Hg_4, and that of hydrochloric acid by H_4Cl_4. But though, according to my second argument, most formulæ would be quadrupled, and though, according to my third argument, they would be merely doubled, and though, according to my fourth argument, certain formulæ, such as NH_4Cl and PCl_5, would even remain unaltered, still they all point in the same direction—they all indicate that the greater part, if not all chemical formulæ, should be doubled or otherwise multiplied.

Each of the arguments should be taken upon its own merits; it is quite possible that some chemists might admit the strength of one argument who would, like Dr. Stevenson, be "quite unable to grasp" another; and the object I have in view will be attained whether the formula of hydrochloric acid be doubled or whether it be otherwise multiplied.

I will now offer a few words in defence of my "argument from geometrical considerations." I have endeavoured to imagine what would be the smallest number of atoms capable of occupying space of three dimensions, regarding the atoms as "infinitesimally small points, or centres of force, distributed through space, not filling it, but merely occupying it, or indicating its boundaries." Now, a little consideration will show that one such point or atom might serve to indicate a given position, two points or atoms would serve to indicate the extremities of a straight line, three points or atoms would be the lowest number capable of indicating a superficies—which would, of course, be a triangle—and four points or atoms would be the lowest number capable of indicating the boundaries of a solid figure, which would be a tetrahedron.

The only reason why I have chosen the tetrahedron is because it is the simplest figure I could have selected for the purpose. I might have taken a cube, but then eight points or atoms, at least, would be required to indicate its boundaries. I think it will be obvious that, in accordance with this idea, it is quite possible for five or any higher number of atoms to occupy the same space as the four which serve to indicate the boundaries of the tetrahedron; only they would, of course, be more closely packed. It is also, in accordance with the same idea, impossible to conceive less than four atoms as capable of occupying any space at all.

Dr. Stevenson has no difficulty in conceiving that two atoms can occupy the same space as four; I almost doubt, however, if he is prepared to go a step further, and main-

* "Dr. Muspratt's Chalybeate or the Chloride of Iron Spring," in the "Royal Chalybeate Spa" rooms.

tain that one atom is capable of occupying the same space as two.

When, in my fourth argument, I say that instead of regarding the four volumes occupied by chloride of ammonium and pentachloride of phosphorus as due to dissociation, we may look upon them as representing the true state of affairs, and double other formulæ to make them correspond to the same volume—that is to say, we may look upon the relative formulæ of chloride of ammonium and of ammonia as NH_4Cl in the one case, and N_2H_6 in the other—I think it is manifest that, for the purposes of this particular argument, I leave the formulæ of chloride of ammonium and pentachloride of phosphorus untouched, as NH_4Cl and PCl_5, whilst doubling those of ammonia N_2H_6, and terchloride of phosphorus P_2Cl_6, so as to make them occupy the same volume.

On this point, I have been completely misunderstood by Dr. Stevenson. He says that I "appear to reject dissociation as the true explanation of the phenomena, and prefer doubling the usual formulæ of these compounds"—*i.e.*, of chloride of ammonium and pentachloride of phosphorus. Now it is clear that doubling the formulæ of chloride of ammonium and pentachloride of phosphorus, so far from reconciling the vapour densities of those bodies with that of ammonia and terchloride of phosphorus, would make the discrepancy between them twice as great as it is at present.

Dr. Stevenson speaks of the "four volumes as representing the true state of affairs with regard to the vapour of chloride of ammonium and pentachloride of phosphorus" as "a fact which it would be hardihood to deny;" but, nevertheless, he virtually denies it, because according to the principle of dissociation, which he admits, it is not by chloride of ammonium and pentachloride of phosphorus that the four volumes are occupied, but by the ammonia and hydrochloric acid in the one case, and by the terchloride of phosphorus and free chlorine in the other, into which they are supposed to be dissociated.

With regard to my fifth argument, in which I mention that "all the elements would be united with an even number of atoms," if we double the formulæ, I readily admit that if we multiply the formulæ by an odd number, the present variety will still be maintained.

With reference to the question, "What is the quantivalence of carbon in C_2H_8, of nitrogen in N_2H_6, of oxygen in O_2H_4?" I have already endeavoured to explain how the two atoms of nitrogen in N_2H_6 are linked together, by supposing that they interchange two affinities—the single atom of nitrogen being quinquivalent as in NH_4Cl. I have, however, on a former occasion, gone fully into this subject (Chemical News, May 18, 1866), and have then observed that the "apparent quantivalence of an element affords no absolute proof of the real or maximum quantivalence which it would exhibit were its atoms in a thoroughly free condition." We may, therefore, suppose the real quantivalence of a given element to be anything we please over and above its apparent quantivalence.

I will only observe, in conclusion, that when Dr. Stevenson says "that the carbon in C_2H_8 must exchange at least two affinities, and be at least quinquivalent," he evidently means that the two atoms of carbon interchange one affinity. Again, when he says that the "nitrogen in N_2H_6 must exchange at least two affinities, and be at least quadrivalent," he evidently means that the two atoms of nitrogen interchange one affinity.

Laboratory, 19, Great St. Helen's, E.C., July 11.

On Ozone and Antozone, by M. C. Weltzien.*

(Continued from page 40.)

The Preparation of Ozone and Conditions of its Production.—M. Houzeau having obtained ozone by making sulphuric acid react on peroxide of barium, one might conclude that this ozone would also be produced by the action of hydrochloric acid. Sir B. Brodie has also studied the action of hydrochloric acid on peroxide of barium. He found that with concentrated acid he produced chlorine and a weak solution of peroxide of hydrogen, and that, at a certain degree of concentration, the two reactions take place simultaneously. He believes that this action takes place in obedience to a certain law, and, from the result of his experiments, he constructs a curve of the decomposition of hydrochloric acid. The reactions which may be produced are explained by the following equations:—

$$BaO_2 + 4HCl = BaCl_2 + 2H_2O + Cl_2.$$
$$BaO_2 + 2Cl_2 = BaCl_2 + O.$$

and finally

$$3BaO_2 + 8HCl = 3BaCl_2 + 4H_2O + Cl_2 + O_2.$$

I have made dry hydrochloric acid gas react upon peroxide of barium contained in a tube; the peroxide became much heated, and became covered with a crust of chloride of barium, which prevented the continuation of the operation.

I then made hydrochloric acid react upon pulverised peroxide of barium, mixed with sand and enclosed in a balloon. In both cases I obtained, besides oxygen and chlorine, some ozone, recognisable by its odour, and the balloon containing the residue of the reaction retained the smell for several days. In most cases no ozone, but only oxygen and chlorine, are produced, probably mixed with hypochlorous (?) acid.

As to the formation of ozone in the air, some seems to be produced during storms, as M. Schoenbein's experiments show; but I do not think it remains long. To ascertain its presence the reaction of iodide of potassium is insufficient, and the oxidisation of silver can alone be regarded as a certain proof.

In a memoir published in 1860, I enunciated, contrary to the views of Clausius, the theory that ozone is oxygen formed of two atoms. Since that time, some very valuable experiments on ozone have been made by MM. de Babo, Claus, and Soret, and especially on its density. These *savants* propound the same opinion—namely, that ozone is oxygen denser than ordinary oxygen; only M. Soret, considering ozone as a molecule formed of three atoms of oxygen, has named it binoxide of oxygen.

Clausius thus expresses himself on the subject:—"M. de Babo supports an opinion previously given by M. Weltzien, and from which I differ, as it regards ordinary oxygen as formed of simple atoms, and ozone as constituted by these diatomic molecules, and he promises a new memoir furnishing the proofs of this theory."

This is an error, for in my memoir there is not a word which could be interpreted in this sense; as to the proofs in support of my opinion, I have given them. They are, the great activity of ozone, especially with regard to silver, and its decomposition by heat.

Lately M. Soret has published some new researches on the density of ozone, in which, relying on the absorbing powers of essences of turpentine and cinnamon, he arrives at the result that the density of ozone is one and a half that of oxygen; the formula of ozone is then O_3.

* *Bulletin de la Société Chimique*, May, 1866.

Dr. Odling, confirming Dr. Andrews, comes to the same conclusion.

In all these cases what appears to be now decided is that ozone is condensed oxygen.

On the Supposed Nature of Air prior to the Discovery of Oxygen, by George F. Rodwell, *F.C.S.*

(*Continued from vol.* xii., *page* 295.)

XV. John Mayow.—We have mentioned in the preceding paper that, from an early period in the history of physical thought, the scientific had admitted a relationship between the air and nitre—undefined, indeed, and unintelligible, yet too palpable to be denied. The fixity of this theory is proved by the fact that it was maintained by philosophers who differed in the generality of their views, and who were more wont to oppose each other than to agree even upon the most trivial point. In this instance they acknowledged the main fact, and only differed as to the precise nature of the relationship. Towards the middle of the seventeenth century the theory was established upon a firmer basis; it was inevitable, in a period when the physical sciences began to engage the serious attention of mankind, when scientific literature was on the increase and new instruments and modes of research were perpetually invented, while experimenters were arising on all sides—it was inevitable, we say, that the value of a theory which had endured for so long a time should be critically examined.

We have before mentioned that Robert Hooke was the first who threw much light upon the subject by asserting as part of his theory of combustion* that there is "a substance inherent and mixed with the air which is like, if not the very same, with that which is fixed in saltpetre," and which is the "dissolvent" of combustible bodies. Unfortunately the experiments upon which this theory was founded were never published, and we are thus left completely in the dark as to their nature and the extent to which we may rely upon them.

Hooke's theory of combustion was eagerly embraced by an Oxford student named John Mayow,† who in 1674 published a volume of essays,‡ in which he extended the theory, and detailed a number of very ingegenious experiments in support of it.

Mayow commences his treatise by affirming that nitre consists of an alkaline salt united with an acid, which latter derives its active principle from the air. This principle produces combustion, and is the cause of acidity. Mayow calls it "*fire-air*," "*nitre-air*," and "*nitro-aërial spirit*" indiscriminately; it will perhaps be most convenient for us to speak of it throughout as *nitre-air*. The atmosphere does not consist entirely of nitre-air, as is proved by the fact that when a candle is allowed to burn in a jar of air standing over water, a portion only of the air is consumed. Nitre-air is not itself combustible, but it causes combustible bodies to be consumed by producing a fermentation (*fermentatio*), for combustion is a very destructive kind of fermentation. Nitre contains no combustible matter, as may be proved by throwing a small quantity into a red-hot crucible, when it will be observed that ignition will not take place until some combustible body has been added. Nitre-air is condensed in large quantities in nitre; it is for this reason that combustible bodies mixed with it can burn in vacuo, or under water. But although the nitre-air is all contained in the acid of nitre, the latter cannot inflame combustible bodies when poured upon them, because the nitre-air particles are surrounded by particles of water. It is needless to remark here that Mayow was unacquainted with the now familiar experiment of pouring turpentine into nitric acid.

Mayow attributes the increase of weight experienced by antimony during calcination to the fixation of nitre-air, a supposition borne out by the fact that he procured a substance exactly resembling calx of antimony by treating the metal with nitric acid, and evaporating. Vitriol of iron is produced from marcasite by nitre-air forming an acid with the sulphur of the mineral, which acid unites with the iron. Rust of iron is formed by the union of nitre-air with iron. Vitriol of iron is a perfect vitriol, while rust is an imperfect vitriol.

Nitre-air is present in all acids; sulphuric acid is produced by the union of nitre-air particles with sulphur; wines are changed into vinegar by the assimilation of nitre-air from the atmosphere. Nitre-air is also the cause of fermentation and of putrefaction; hence bodies covered with butter or oil, or otherwise kept out of contact with the atmosphere, do not putrefy.

Mayow treats at some length of the analogy between respiration and combustion, and we are here introduced to the first experiments in pneumatic chemistry.

A piece of camphor dipped in melted sulphur was supported in a glass jar, A, Fig. 1, standing over water. As

Fig. 1.

stoppered air jars were not known at the time (from the simple fact that they had hitherto been unneeded), Mayow was obliged to adopt some special means for rendering the height of the water inside and outside the jar the same; he effected this by introducing a small siphon B, which was placed in the position shown in the figure during the depression of the jar into the water vessel C, and was afterwards withdrawn. The camphor

* For an account of this theory see the tenth of these papers, Chem. News for February 17, 1865.

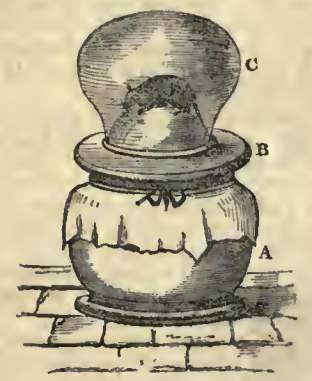
† Born 1645, died 1679.

‡ This work is entitled "Tractatus quinque Medico-physici. Quorum primus agit de Sal-nitro et spiritu nitro-aëreo. Secundus de Respiratione. Tertius de Respiratione fœtus in utero et ovo. Quartus de Motu Musculari et spiritibus animalibus. Ultimus de Rachitide. Studio Joh. Mayow, LL.D. et Medici, nec non Coll. Omn. Anim. in Univ. Oxon. Socii.—Oxonii 1674." The Vice-Chancellor's order for printing the work is dated July 17, 1673; it was therefore completed in Mayow's twenty-ninth year. The first edition is very scarce, but the 1681 edition printed at the Hague is comparatively common. The treatise on respiration was first published in 1668, in Mayow's twenty-third year.

was then fired by the lens D. When it was extinguished, and the water had ceased to rise into the jar, he attempted to fire the remaining camphor, but without success.

In order to prove that air is diminished in volume by breathing, Mayow procured an open glass jar, A, Fig. 2,

FIG. 2.



and tied firmly over the opening a piece of bladder B, upon which he inverted a cupping-glass C containing a mouse. The edges of the cupping-glass were pressed firmly upon the bladder, so as to prevent communication with the outer air. It was soon observed that the bladder was pressed up into the cupping-glass, because, says Mayow, an inequality of pressure has been produced by the diminution of the bulk of air within the cupping-glass caused by the breathing of the mouse.

The experiment was modified by placing the mouse in a vessel inverted over water, when it was found that water rose into the vessel as the animal continued to breathe, and by roughly graduating the vessel Mayow calculated that the air was diminished one-fourteenth by breathing. He then attempted to ignite combustible matter in a closed vessel in which an animal had been suffocated, but without success—a proof that air which is unfit to support life is also unfit to support combustion. It was thus conclusively proved that during the processes of respiration and combustion there is a something abstracted from the air necessary for the maintenance of those processes, and that the residue is unfit to support either life or combustion.

A mouse was placed in a jar of air inverted over water, together with a lighted candle; the latter speedily went out, and the mouse lived only half the time that a mouse lived in the same bulk of air when the candle was not present; hence, argues Mayow, respiration and combustion both deprive the air of the same kind of matter—viz., of nitre-air.

Air deprived of its nitre-air particles is lighter than atmospheric air, because a mouse placed near the top of a closed vessel of air dies sooner than when it is placed near the bottom of the vessel; and if we take two mice and place one at the top and the other at the bottom of a closed vessel, that at the top will die before the other.

Mayow made several experiments to determine whether air can be generated *de novo*, and the first artificially produced gas which he examined, in order to ascertain whether it was atmospheric air, was hydrogen, which, as we have seen, was procured some years previously by Boyle. In order to determine whether this gas was capable of as much expansion as air, Mayow made the following experiment:—hydrogen was procured by inverting a vessel of water over small pieces of iron placed in a vessel containing dilute sulphuric acid, and some of the gas was transferred § to a graduated tube in sufficient quantity to occupy the space of one division. The tube, with its lower end dipping beneath the surface of water, was then placed under an air-pump receiver, which was exhausted as completely as possible. The gas expanded to about two hundred times its original volume, and atmospheric air was not found to expand to a greater extent. It was thus ascertained that this property is common to both kinds of air; but the experiment proves nothing as to the nature of the generated air, because Mayow had previously found that air in which a candle had been extinguished was capable of expanding to a similar extent.

In order to ascertain whether air procured from iron filings and dilute sulphuric acid was respirable, Mayow placed a mouse in an inverted vessel partially filled with air, and noted the length of time before it died: the same volume of air was then passed into a similar vessel, a mouse introduced, and a large volume of hydrogen transferred to the vessel; but the mouse lived scarcely longer than its predecessor, whereas if the new air were respirable it ought to have lived two or three times longer. Mayow attributes the fact of its living rather longer to the dilution of the nitre-air particles by the introduced gas, and the consequent prevention of their rapid consumption.

We have seen that almost every writer on the nature of the air has touched upon the subject of respiration. In the first of these papers we have the theories of Plato and Aristotle; in almost the last that of Boyle. It was natural that a question so intimately connected with life should from the earliest ages engage the attention of mankind—indeed, almost the only evidence which the ancients possessed of the existence of air was derived from its observed necessity to animal life. From the continued observation that the cessation of breathing was the cessation of life, the belief became prevalent that the soul passed from the body with the last expiration of air; hence the expressions "*efflare animam*," "*exhalare animam*," "*expirare animam*." Again, πνεῦμα, *spiritus*, and *anima*, have each the triple meaning of *soul*, *breath*, and *wind*, and Mr. Hodges informs me that in Hebrew the word נְפַשׁ means "efflare animam," also that רוּחַ has the three meanings of *soul*, *breath*, and *wind*. The close connexion existing between the function of respiration and the principle of life being thus clearly recognised and acknowledged, we cannot wonder that a number of theories were promulgated in every age to account for the precise nature of that function.

The more important of these theories were combated by Mayow in a treatise "On Respiration," which was far in advance of those of all previous writers on the subject. He had proved that only the nitre-air particles of the air are necessary for the support of life, and he contends that these particles are absorbed by the blood, whilst the rest of the air is rejected. The absorption of nitre-air produces heat in the body, and it is the object of respiration to produce animal heat, which arises from a kind of fermentation caused by the union of nitre-air with the combustible particles present in the blood. In like manner muscular motion is caused

§ The gas was transferred from one vessel to another by the method adopted in the present day, which, we believe, was devised by Mayow, since we have seen no mention of it in any work earlier than the treatise we are considering.

by nitre-air uniting with combustible particles in the structure of the muscle. During violent motion we breathe quickly because nitre-air is required in greater quantity than when we are at rest, to supply the greater amount of muscular motion called into activity; and as combustible particles are removed very rapidly from the body under such circumstances, we require food containing a large quantity of such particles before and after violent action. When the chest is expanded, air, by its elastic force, rushes into the lungs, which are composed of a number of minute bladder-shaped membranes, through which nitre-air passes to the blood.

Mayow's work is remarkable in several respects. In it he conclusively proved that respiration and combustion are analogous processes; he upset the four-element theory by demonstrating the compound nature of air; and he recognised oxygen and nitrogen as clearly and almost as notably as they were recognised a hundred years later—the one the supporter of life and combustion, the principle of acidity, and the cause of fermentation and putrefaction, heavier than atmospheric air; the other incapable of supporting life or combustion, and lighter than atmospheric air. We find, moreover, in this work the dawn of the idea of chemical affinity, in the "fermentation" which he speaks of as taking place between nitre-air and combustible particles, and as tending to the production or destruction of things. Mayow even employs some of the terms in general use in the present day; thus he speaks of "*affinitas*" existing between acids and earthy substances, and uses the words "*combinetur*" and "*combinentur*" in speaking of the "*congressus*" of different substances.

The treatise is characterised by much clear and condensed thought, well-sustained argument, and accurate reasoning; moreover, we seldom meet with instances of too hasty generalisation—always the dominant source of error in the early development of a science. We further observe a great advance towards that exact and discriminative mode of thought which is necessary for the investigation of chemical phenomena. The period in which Mayow wrote was, as regards chemistry, a period of transition; there was as yet no work on scientific chemistry, yet Mayow's treatise approached more nearly to such a work than that of any of his predecessors. The works of previous writers in this direction belonged to one of the three following classes; they were either chemico-metallurgic, chemico-medical, or alchemical treatises; or they partook of the nature of all three. The publication of works on alchemy was fast waning before the advances of the new philosophy; for as superstition retreated, and as men began to devote their energies to the legitimate investigation of Nature, a false and chimerical art must of necessity cease to find votaries. Mayow was the first to discuss the intimate nature of an intangible body; other writers had treated of the air as a whole, but no one had endeavoured to ascertain the nature of its internal constitution, or to determine why it produces certain changes in surrounding bodies, upon what these changes depend, and the nature of the constituent or constituents of the air producing them. The old dogma of the elemental nature of the air was received as an absolute truth, although entirely unproven; it was thought that a theory which had been received since the earliest ages must of necessity be correct, and no attempt was made to disprove it

We see from the above that it was the investigation of the nature of nitre which led to the knowledge of the constitution of the air. Mayow remarks at the commencement of his treatise that so much had been written about nitre that it would appear "*ut sal hoc admirabile non minus in philosophia, quam bello, strepitus ederet; omniaque sonitu suo impleret.*" And, indeed, from the time of Mayow nitre *has* made almost as much noise in philosophy as in war. If on the one side it has subdued unruly factions, has it not on the other destroyed obstinate theories? If it has dispersed turbulent assemblies, has it not dissociated the most firmly united compounds? New dynasties have arisen by its aid alike in the realms of the earth and of philosophy. The greatest of the philosophic dynasties which has thus arisen was established by Mayow, and it has endured almost unchanged to the present day—a monument alike to his ingenuity, his perseverance, and his scientific ardour.

TECHNICAL CHEMISTRY.

A Theoretical Study of the Manufacture of Soda by Leblanc's Process, by M. J. Kolb. (Second Part.)*

(*Continued from page 41.*)

The next table given by the author is a rearrangement of the two previous to show more plainly the influence of the elevation of temperature during the digestion:—

Table 3.—Influence of Temperature.

100 grs. of ash.	Temperature (Centig.). 15°.	40°.	60°.
In 350 c.c. of water for 24 hours:			
$NaOCO_2$	34·70	31·40	31·70
NaO	5·70	7·80	7·60
NaS	traces	0·15	0·30
In 350 c.c. for a week:			
$NaOCO_2$	31·50	25·80	26·40
NaO	7·60	9·50	7·20
NaS	traces	2·20	3·70
In 500 c.c. for 6 hours:			
$NaOCO_2$	38·51	37·36	31·49
NaO	3·29	3·94	6·78
NaS	0·25	0·25	0·65
In 500 c.c. for 24 hours:			
$NaOCO_2$	38·58	35·36	26·80
NaO	3·29	5·05	6·71
NaS	0·25	0·40	4·70
In 500 c.c. for a week:			
$NaOCO_2$	37·02	34·21	25·50
NaO	4·23	5·67	6·62
NaS	0·25	0·40	5·90
In 1000 c.c. for 6 hours:			
$NaOCO_2$	40·19	35·92	34·20
NaO	2·34	4·40	5·40
NaS	0·25	0·45	0·75
In 1000 c.c. for 24 hours:			
$NaOCO_2$	38·56	34·23	31·10
NaO	3·30	6·04	6·62
NaS	0·25	0·75	2·00
In 1000 c.c. for a week:			
$NaOCO_2$	32·18	31·40	23·20
NaO	4·97	6·36	6·66
NaS	0·30	0·80	7·80
In 2000 c.c. for 6 hours:			
$NaOCO_2$	38·21	36·10	37·91
NaO	3·32	4·67	3·34
NaS	0·20	0·50	0·60
In 2000 c.c. for 24 hours:			
$NaOCO_2$	37·62	34·68	33·10
NaO	3·84	5·94	6·15
NaS	0·35	0·53	1·00
In 2000 c.c. for a week:			
$NaOCO_2$	34·59	31·50	19·50
NaO	5·28	6·31	6·31
NaS	0·51	1·48	10·21

* Abstract from *Annales de Chimie et de Physique*, June, 1866, p. 135. For abstracts of the former part of the author's memoir see Chem. News, vol. xiii., pp. 140, 162.

From a comparison of the figures in the three foregoing tables we may draw the following conclusions:—

The quantity of water has no very marked influence on the causticity, which, however, increases with the length of the digestion, and also with the elevation of the temperature.

The proportion of sulphide of sodium goes on increasing with the quantity of water, and more especially with the length of the digestion and the rise of temperature.

The diminution of carbonate of soda coincides not only with the formation of caustic soda, but is equally in relation with the variation of sulphide of sodium, which proves that this last is formed at the expense of the carbonate and not of the caustic soda. There appears, indeed, to be no relation between the proportion of caustic soda and sulphide of sodium.

So far as the causticity is concerned, there is nothing surprising in the results; but the results of the sulphuration of the leys were more astonishing, and the author endeavoured to trace the causes. For this purpose he studied the action of water first on pure sulphide of calcium alone, and then with carbonate of soda, soda, and lime, singly and altogether. Sulphide of calcium is but slightly soluble in water. A litre, after forty-eight hours, dissolved

At a temperature of	15°	0·15 CaS
„ „	18	0·23 „
„ „	40	0·30 „
„ „	60	0·48 „
„ „	90	0·33 „
After boiling for two hours		0·27 „

The presence of common salt was found to diminish the solubility, which partly explains how it is that ashes containing salt are generally less sulphuretted than others.

Sulphate of soda appears to have an opposite effect, the solubility of the sulphide of calcium being slightly increased.

The action of lime appears to be irregular. A litre of lime-water at 60°, after forty-eight hours, dissolved 0·18 CaS, while a litre of milk of lime, in the same time and at the same temperature, dissolved 0·55. These solutions are only the transformation of the sulphide of calcium into the sulphydrate of the sulphide and into lime—

$$2CaS + Aq = CaS,HS + CaO + Aq.$$

This transformation takes place slowly, for the proportion of sulphur made soluble increases with the length of the digestion; and boiling water, which after two hours gives but little soluble sulphide, contains large quantities if the boiling be continued for one or two days.

A solution of caustic soda containing 3·15 grms. in a litre, at 10° and even on boiling, took up merely traces of sulphide of calcium. It was the same with solutions containing 16·7 grms. 42 grms., and 79 grms. NaO. But when the same solutions were boiled or digested for forty-eight hours the reaction

$$CaS + NaO = CaO + NaS$$

took place.

When, however, the lime and sulphide of sodium were boiled or digested together, no change whatever happened. It appears, then, that when once the sulphide of sodium is formed, the lime has no further action upon it, although its presence has a notable influence on the changes which may take place between the carbonate of soda and sulphide of calcium.

M. Kolb next gives a table showing the progress of the decomposition which goes on between these bodies, according to the temperature, duration of contact, amount of water, and the presence of lime or caustic soda. We need only in this case give the results arrived at. The amount of sulphide of calcium dissolved or decomposed in water is, as we have seen, very small, but it increases with time and temperature. Lime has no sensible influence on this solubility, but caustic soda is a decided impediment to the solution, especially at the ordinary temperature.

So far as carbonate of soda is concerned, the concentration of the liquor is a powerful obstacle to the reaction

$$NaOCO_2 + CaS = NaS + CaOCO_2.$$

This decomposition, indeed, which is well-marked in very dilute liquors, diminishes until it becomes inappreciable in a saturated solution of carbonate of soda. It is, however, increased by length of digestion and elevation of temperature.

The presence of caustic soda in small quantity puts another obstacle in the way of the action of carbonate of soda on sulphide of calcium; lime produces exactly the same effect, which is not astonishing, since the effect is probably not produced by itself, but by the caustic soda formed.

We need not detain our readers over the general conclusions of the author, to which we have before alluded. The most important point dwelt on is the advisability of rapidly lixiviating the ash, and the great desideratum is an apparatus to effect this.

PROCEEDINGS OF SOCIETIES.

ROYAL SCHOOL OF MINES, MUSEUM OF PRACTICAL GEOLOGY.

A Course of Twelve Lectures on Chemical Geology, by Dr. Percy, F.R.S.

Lecture No. VII.

The first subject for this morning's consideration is that of clay.

We are all familiar with the term clay, but under that term are included bodies which differ considerably in external appearance, and also in chemical composition. They are, however, all essentially hydrated silicate of alumina—silica combined with alumina and with water. The water is there in a state of actual positive chemical combination. They are not definite compounds. In almost every case you will find them to be mixtures of a silicate of alumina of definite constitution, with an excess of silica, and there are also present other bodies in small and variable proportion, which take no part whatever in the chemical constitution of the mineral. A clay, when it loses its water by exposure to heat—say a red heat—becomes what is termed dehydrated, deprived of water, and then its properties are altogether changed. As a familiar example, take the case of common brick. That is nothing more than a dehydrated silicate of alumina. The clay has been fashioned into a bricklike form, and exposed to a temperature at or above redness, and so deprived of water. The product has lost all plasticity—that is, all capability of being moulded again—although it may be pounded and mixed with water. The plasticity of the clay depends on the fact of a certain amount of water being in actual combination with the silicate of alumina. Take that water away, and then, I say, the plasticity is immediately lost.

There are various kinds of clay known to us. Perhaps one of the most typical is the well-known china clay, or kaolin, which is the Chinese word. The Chinese, you know, are adepts in making china ware. Hence the name. They use two materials especially for that purpose—

kaolin, which is china clay, and silica. Those two in mixture constitute essentially the material of china. Kaolin is one of the purest kinds of silicate of alumina with which we are acquainted. It is prepared largely in Cornwall. It is, in fact, the result of the weathering, or decomposition by exposure, of the felspar contained in certain kinds of granite. In Cornwall there exists much of that granite, which undergoes disintegration or decomposition by the continued action of moisture. The felspar becomes decomposed, and is resolved into silicate of alumina, hydrated, and also into certain other products which are washed away; for instance, almost the whole of the alkali is removed, but not the whole. There is always some alkali left in clay in spite of the weathering, however perfect it may be. There is also a certain proportion of silica always removed. I will show you the transformation presently by means of a simple formula. The granite undergoes decomposition by exposure: it gets washed and levigated, to use the old chemical phrase; there is a portion of silica removed, and there remains kaolin. I will place before you an analysis of kaolin. It is not one of ours, but I have no doubt this is perfectly accurate and typical so far as regards the proportions of silica and alumina. You see it contains

Silica	46·32 per cent.
Alumina	39·74 ,,
Combined water	12·67 ,,

The silica and alumina are the chief constituents. The water I have stated, is water which cannot be displaced by gentle desiccation, but can only be driven out by exposing the clay to a red heat. Then you will observe there are other bodies present in small quantity—

Lime	0·36 per cent.
Magnesia	0·44 ,,
Protoxide of iron	0·27 ,,

and there ought to be potash. I have no doubt that all kaolin contains potash in a notable quantity, but, as I said previously, the determination of alkali involves a good deal of trouble, and unless there is some reason for it, chemists will generally shirk the task of estimating it.

I have also an analysis of some fire-clay—one of the best we have. It is found in the coal measures of South Staffordshire, and is largely used there for the purpose of making pots for glass-makers.

Silica	65·10 per cent.
Alumina	22·22 ,,
Water	7·10 ,,
Potash	0·18 ,,
Lime	0·14 ,,
Magnesia	0·18 ,,
Protoxide of iron	1·92 ,,
Phosphoric acid	0·66 ,,
Organic matter	0·58 ,,

The potash occurs only in small quantity. It is a very troublesome ingredient in the clay, refractory clay or fire-clay being intended to resist high temperatures. It is a very troublesome thing when the potash amounts to 1 or 2 per cent.; it then renders the clay much more easily softened by heat than it would otherwise be, or even fusible. So also with regard to lime, which in a certain proportion is also injurious. There is sometimes a little manganese present in this fire-clay. You see it contains a little phosphoric acid, and I have no doubt that that would be much more generally found in recorded analyses if they were more carefully and scrupulously conducted. Phosphoric acid is a thing which in its determination gives trouble. Then we have a certain proportion of organic matter present upon which the colour of these fire-clays depends. These clays are always more or less coloured; some have a deep colour, almost brown. Here is one of them; it is, in fact, one of those of which I am giving an analysis. It has a dark greyish colour, due entirely to finely disseminated coaly matter. There is also a little hygroscopic water stated in the analysis—2·18 per cent. Now, what is the difference between the hygroscopic water and the combined water? Why, the fact is, you can displace the hygroscopic water by gentle heat, and when the clay is cold it may reabsorb it in even a larger proportion. The water is simply in the clay as so much mechanically mixed matter. Not so the combined water. The moment you displace that, you entirely alter the properties of the clay. It is the combined water which constitutes it a hydrate. Now cast your eye for a moment on the quantity of silica represented by the top figures, 65·10 per cent. You say there is a difference in the composition of the two clays I have brought before you. So there is; but I have no doubt this fire-clay is essentially one of which the other analysis represents nearly the composition. It is a silicate of alumina mixed with foreign matter; that foreign matter is to a large extent, in this case, silica, which may be separated easily by a washing process. It is so much sand diffused. We know that because we have made exact experiments upon it. In fact, we have determined the proportion, and in order to make the experiment a simple apparatus may be adopted. I cannot perform the experiment before you, because it would not be striking, and it would take too long a time; but there may be some gentleman present interested in agriculture, and for his sake I will explain the process of determining the silica in clay. We first of all reduce the clay to powder and leave it in water for a long time, or by preference boil it thoroughly. The object of this is to disintegrate it as completely as possible. In the manufacture of pottery it is customary to boil the clay. Having disintegrated the clay, we take a glass—say, like the old-fashioned champagne glasses, with no stem to it. At the top you affix a piece of brass—a brass rim, and to that rim you have a little spout bending over. Then you introduce a common glass tube descending to the bottom of the glass. The tube should be drawn out somewhat at the lower extremity to a fine point. Then at the upper part it should terminate with a funnel or mouthpiece. The glass tube is placed in the glass. That done, let a current of water from a tap flow down the glass tube. Then put the piece of clay, which you have reduced to powder by boiling in water, or otherwise disintegrated, into the glass, and leave the apparatus for a long time, allowing the stream of water to flow down the tube. Now, the lightest particles of the clay will be removed and flow over the edge through the spout. They will be the silicate of alumina; and the sand will separate at the bottom. Continue this operation for a considerable time, and you will find the pure sand at the bottom. Then, by repeating the process of levigation again, you can make a tolerably correct estimate of the amount of silica present mechanically, independent of that combined as silicate of alumina.

Now for an analysis showing how clay may be derived from felspar. We will take, for the sake of illustration, two equivalents of felspar. Two equivalents of felspar will contain two equivalents of potash, two of alumina, and eight of silica—

$$2KO + 2Al_2O_3 + 8SiO_3.$$

You will find that by doubling the formula I gave you for felspar you will get at those numbers. Let us take from this two equivalents of silicate of alumina—

$$2(Al_2O_3SiO_3).$$

I have used the formula which is most generally accepted as correct for silicate of alumina now-a-days. There is some difference of opinion in regard to the constitution of this kaolin or silicate of alumina. The presence of free silica renders it very difficult to get a pure body to act upon. Well, having taken away those two equivalents of silicate of alumina from the two equivalents of felspar, there will remain two equivalents of potash and five of silica; or—what is equal—take away two equivalents of potash and five of silica, and that will leave you

two equivalents of silicate of alumina, or kaolin. Well, that represents exactly what takes place in the weathering action, occurring in nature or artificially excited, by which kaolin is produced from felspar.

A curious matter turned up some four or five years ago in North Wales, and we have never yet been certain about the constitution of it, though we have made several inquiries into it. It is a micaceous or mica-like body. It has been examined crystallographically by Professor Miller, of Cambridge, and we have made several analyse of it which have not been published. It appears to be a definite silicate of alumina, represented by the formula which I have just employed. It is a body requiring further examination, which, indeed, it ought to have received long ere this.

Note especially the presence of potash or soda in all these clays. I will be bound to say there is no clay without one or other or both of those alkalies. You will generally find potash, and sometimes soda, to the extent of 2 or 3 per cent. We have them recorded in analyses of our fire-clays. Occasionally we have found both alkalies in such clays. Now, these fire-clays are often associated with coal, as we shall hereafter see, and no doubt this association may indicate the conditions under which some of the coal plants have lived. The presence of those alkalies would indicate a marine origin.

Phosphoric acid is also present; and we also find bisulphide of iron diffused in small particles in these clays. It is not unfrequently present, and when it is there it is sometimes a source of great inconvenience to the brickmaker in the burning of the bricks. In consequence of a large quantity of free oxygen being contained in the air, the iron pyrites becomes oxidised when the clay is burned, and an oxide of iron is produced, which acts rapidly on the silicate of alumina. The silicate of alumina is fluxed by the iron pyrites, and little perforations occur all over the bricks. In examining a fire-clay it is always desirable to examine this point especially, and that may be easily done by subjecting the clay to a process of levigation similar to that I described just now when speaking of the separation of free silica.

Clay forms, as you know very well, a very large part of the earth's surface. London, for example, rests, to a large extent, on clay. When we consider these facts with reference to the production of kaolin and so forth, there can be no doubt whatever, as I said before, that all these clays have been derived from felspar, or some analogous silicate. In some cases we have the process going on upon a very large scale; and we can take the felspar and watch its gradual transformation into this substance, kaolin.

Sometimes clay is converted at a high temperature into a mineral called porcelanite, or porcelain jasper, a very pretty mineral; and this mineral we sometimes find imitated accidentally on coal-heaps which have been ignited for a long time. The shelly matter being exposed to a long-continued heat becomes converted into porcelanite; and where we find it we know perfectly well that heat has existed. There are circumstances which justify the inference that porcelanite is nothing more than clay which has been transformed by heat. I have seen it frequently upon old pit mounds. Occasionally you will find it presenting a beautiful ribbon-like structure in alternate layers of red and green.

The next division of our subject is one of considerable comprehensiveness and importance. It is that of sulphur and the compounds of sulphur which exist in nature. Of course I shall treat of this department only in reference to geological considerations.

Now, sulphur is, as you know, an elementary body—that is to say, by no known process can it be resolved into simpler forms of matter. Treat it, torture it, as we may, it remains sulphur for ever. There is another element very analogous to it in chemical relations—namely, selenium, a body discovered by Berzelius a great many years ago. Here is a specimen of selenium cast in the form of a medal. These two bodies sometimes occur together; but selenium is of very rare occurrence in nature compared with sulphur. Sulphur burns, you know, with access of air, forming sulphurous acid. We are all familiar with the fumes of burning sulphur; that is nothing more than sulphur united to oxygen chemically, in the form of sulphurous acid. There are various other kinds of combinations and acids. There is sulphuric acid, and there are other sulphur acids.

Sulphur occurs abundantly in nature, even in a state of isolation. Here is a fine specimen of crystallised native sulphur. It is essentially a volcanic emanation, as we shall observe hereafter when we come to treat of volcanic action. It exists to a very large extent in the earth's crust, in combination with metals, forming sulphides. It is also present to a very large extent in the state of salts, saline combinations—in the form, especially, of sulphate of lime, with which you are familiar under the name of gypsum.

Let us first examine these sulphides in a general way. Now, sulphur has a very powerful affinity for many metals. Take, in illustration, the familiar experiment with iron, so often performed by youths at a smith's fire. Obtain a piece of iron, heat it to whiteness, and touch it with sulphur. Instantly the iron trickles down as liquid as water, a combination of iron and sulphur having taken place. Take, again, a little lead, heat it with sulphur, and a combination takes place, accompanied by the phenomenon of incandescence. In fact, sulphur combines with many metals, producing great heat and light—in other words, causing incandescence.

We will study in detail some of the most important sulphides which we meet with. They differ considerably in their properties, but they are all solid. They are either amorphous—that is, without form—or they are crystallised. They sometimes occur magnificently crystallised. Look at this specimen of iron pyrites. It is, as you observe, distinctly crystallised, and sometimes we obtain it in very fine crystals—large cubes or modifications of the cube, and also in other crystalline forms. Take, again, common galena, sulphide of lead: here it is, forming a large crystalline mass. Here you can trace distinctly the form of cubes. Again, you have these sulphides presenting a metallic appearance. Here is one which some persons would pronounce a metallic substance, but it is merely a metallic compound. Then, again, we have a compound of sulphur and mercury, which is without any metallic lustre. Here, again, is a combination of sulphur and antimony. What is very singular is, that we may have the same sulphide in two distinct forms, each of them possessing precisely the same chemical composition, and yet no two bodies differing more in external characters than these two forms of the same sulphide. I could place before you several illustrations of this fact. Here is some sulphide of bismuth which has been thrown down from a solution of bismuth. It is in the form of a black powder, perfectly non-metallic in appearance. Take this black powder, expose it to a good red heat, and you then obtain a beautifully crystallised body having a decided metallic lustre. But here is, perhaps, one of the most striking illustrations you can have. You see this orange powder. It is nothing more than sulphide of antimony thrown down in contact with sulphur from solution. This other specimen is the same compound after being exposed to a red heat and melted. You see it now possesses a bright metallic lustre. There are also different forms of sulphide of mercury. Here it is in the state of common cinnabar, a black powder. If I take this black powder and expose it to a high temperature in a glass vessel, which is essential in this case, I then get this brick-red powder, which has the same composition per cent. Then, again, by taking this dull-red powder and submitting it to a certain treatment, I obtain this beautiful body, vermilion, which has precisely the same composition. These three forms are all sulphide of mercury, all having the same constitution,

and yet you see how different they are in external appearance.

Some of the sulphides are very fusible. As a general rule, the sulphides of the more fusible metals, such as lead and tin, fuse at a much higher temperature than those metals. On the other hand, the sulphides of the more difficultly fusible metals—iron, for example—fuse at a much lower temperature than those metals. There are exceptions, however, to this rule; still it is generally true. The temperature at which they fuse varies considerably. Some are perfectly fixed at whatever temperatures we expose them to. Take a certain compound of sulphur and copper which occurs in nature—the disulphide. If I heat it in a close vessel—(I demand that condition)—I may expose it to the highest temperature we can command in our furnaces, and it undergoes no change whatever. Again, if I take iron pyrites and heat it in a close vessel to the highest temperature I can, it undergoes no change; but if I heat it openly to a good red heat, it then loses about half its sulphur. Other sulphides sublime when heated, and we find such sulphides in volcanic emanations. Sulphide of mercury, for example, is one capable of being thus sublimed. Sulphide of arsenic, also, can be sublimed. There are some points of considerable interest in connexion with the sublimation of these sulphides. Take, for instance, common galena, sulphide of lead. I have seen this body beautifully sublimed in blast furnaces when lead slag was being melted. Beautiful crystals of sulphide of lead have been seen in the upper part of the furnace, showing that it has been sublimed. But then this sublimation can only take place with the exclusion of oxygen. If oxygen have access, you burn out the sulphur and oxidise the metal. In fact, you get a series of changes of great interest in a metallurgical point of view, but which I have not time to dwell upon. The changes which take place by exposing these sulphides to the action of heat and air are very important, and lie at the foundation of some of the most important processes for the extraction of metals from their ores, especially copper, lead, and silver. The sulphides of many of the metals are frequently decomposed by steam at a high temperature. The sulphur goes away in combination with the hydrogen as sulphuretted hydrogen, and the metal becomes oxidised at the expense of the oxygen of the steam.

(To be continued.)

ACADEMY OF SCIENCES.

July 23.

Two papers were read "*On Hexagonal Blende*," and more especially its phosphorescent properties. They were by M. E. Becquerel and M. Sidot. The latter author states that to obtain the most phosporescent sulphide of zinc he volatilises the natural blende or artificially prepared amorphous sulphide in a current of pure and dry sulphurous acid. The sulphide is placed in a porcelain tube, and is strongly heated for four or five hours, after which crystals will be found at the cold end of the tube. M. Becquerel has examined the properties of the crystals so produced, and has found them phosphorescent in the highest degree after insolation. He remarks that the outer crystals in the mass he examined were white, while the inner ones had a yellow tint resembling that of uranium compounds, and this yellow tint, he thinks, is due to a molecular arrangement which is the cause of phosphorescence. Yellow crystals are generally phosphorescent. M. Becquerel examined the light by the aid of the phosphoroscope, and found that the white crystals with a moderate velocity of the instrument showed a beautiful blue light; the yellow crystals showed a greenish-yellow with the lowest velocity, which passed to a blue as the velocity increased, but a blue less deep than that furnished by the white crystals, thus indicating a mixture of the green with the blue light of shorter duration. The coloured crystals thus afford rays of different refrangibility and of unequal duration, like diamonds, silicate of lime, and other bodies. It is observed, however, that the bodies showing blue light are very few in number. M. Becquerel has also studied the effects of the different rays of the spectrum upon hexagonal blende, and has found that the maximum of action is between the lines G and H, rather nearer G than H.

M. G. Planté presented a note "*On the Production of Ozone.*" The author has found that more ozone is produced in the electrolysis of water when the poles are of lead than when they are made of platinum—half as much again, indeed. The fact, he says, is difficult to explain, but he conjectures it is the result of the secondary action of a layer of oxide on the electrode.

M. Cloez entertained the Academy with "*A Mode of destroying Rats and other Animals that burrow.*" The Museum of Natural History at Paris is, or rather was, dreadfully infested with rats, but, thanks to M. Cloez, it is now free from the nuisance. The happy thought of pouring bisulphide of carbon into the holes occurred to this gentleman, and the vapour, we need hardly say, was fatal to all the rats who stopped to inhale it. The description of the funnel and tube by means of which the operation was effected we need not detain our readers with. Those who are curious or simple will find it in the *Compte Rendu* for the date at the head of this article.

M. E. Kopp sent "*On the Use of Nitroglycerine in Stone Quarries*" in his neighbourhood. To avoid accidents in transport M. Kopp prepares nitroglycerine on the spot, and at the time it is wanted. His directions for the preparation and use are clear and precise, and we shall give them at length next week.

NOTICES OF BOOKS.

Annales de Chimie et de Physique. July, 1866.

The chemical papers in this number of the *Annales* are unimportant. We append the titles of all the papers.

I. "*The Quantitative Determination of the Calorific Phenomena produced during the Change of Volume in Metals, and Determination of the Mechanical Equivalent of Heat independently of the Internal Work of the Metal.*" By E. Edlund.

II. "*On the Effects of Coloration and Extinction of Colours produced by Artificial Lights.*" By M. J. Nickles. This paper was read before the Academy of Sciences, and a notice will be found at page 31 of our last volume.

III. "*On the Crystallisations of Tribasic Acetate and Hydrated Oxide of Lead, and Crystallised Anhydrous Protoxide of Lead.*" By M. Payen. The author obtains all these crystals by adding different proportions of ammonia to solutions of acetates of lead of different strengths.

IV. "*On the Vibratory Movements occasioned in Conducting Bodies by the Combined Action of Magnetism and Discontinuous Currents.*" By Professor de la Rive.

V. "*On a New Electromotor.*" By M. Toepler.

VI. "*On the Composition of the Ashes of Vegetables.*" By M. G. Marchand. The author gives analyses of the ashes of wheat, oats, potatoes, beets, carrots, swedes, peas, vetches, trefoil, lucerne, sainfoin, colza, and linseed, together with those of some fuci, and starfish, and, lastly, an analysis of milk.

VII. "*On the Dilatation of Solid Bodies by Heat.*" By M. Fizeau.

VIII. "*Experimental and Theoretical Researches on the Figures of Equilibrium in a Liquid Mass without Weight.*" By M. J. Plateau. In this paper the author gives an improved method of preparing the glycerine and soap compound for giving persistent air-bubbles.

Translations of two papers by Professor Rankine follow, and lastly we have the commencement of a memoir by M. Boussingault "*On the Sensation of Heat produced by the Contact of Carbonic Acid with the Skin.*"

Journal für praktische Chemie. No. 8. 1866.

In this Journal we have Marignac's "*Researches on Niobium Compounds;*" a contribution to the "*Knowledge of Sulphocyanogen Compounds,*" by O. Hermes; and a paper "*On Sulphur Compounds,*" by Pelouze, which will be found in our last volume. There is next a paper, by Dr. Rudolf Weber, "*On the Formation of Sulphuric Acid,*" combating the views of Peligot on this matter. As the subject is of considerable interest, we shall return to the paper. The next paper is by Baudrimont, "*On the Nature of White Phosphorus,*" a notice of which will be found in the Chemical News for Nov. 5, 1865. Then follows a short paper "*On Petolite and Osmelite,*" by Von Kobell, and a communication, by Dr. Gracger, "*On the Determination of Potash in the Presence of Soda,*" in which he gives a convenient and ready method of examining adulterated potashes. To determine the amount of carbonates the author employs a "normal" nitric acid, and he gives a table which shows the amount in cubic centimetres of this normal acid required to saturate one gramme of a mixture of the carbonates of potash and soda of from 1 to 99 per cent. of either. This table will be found very useful by many analysts. The next paper is by Dr. Martius, "*On a Double Compound of Ferrocyanide of Potassium with Nitrates of Potassium and Sodium.*" The author found this compound in the mother liquor of the prussiate when saltpetre is used in the preparation. It is a beautifully crystallised salt of a clear yellow colour, and possesses in the highest degree the property of becoming phosphorescent when the crystals are rubbed or shaken together in the dark. The compound may be obtained by adding a solution of ferrocyanide to a boiling solution of potassium and sodium nitrate. After the greater part of the saltpetre has crystallised out, the mother liquor, on very slow evaporation, will yield the crystals described. At a high temperature they go off like gunpowder. They have the composition—

$$Fe'K_4(NC)6 + 2NaNO_3 + 2KNO_3.$$

The last paper we need notice is by Stolba, "*On the Use of Saturated Aqueous Solutions in determining the Specific Gravity of the Body in Solution.*" The method is obviously good when a perfectly saturated solution is obtained, but its application must require many precautions.

NOTICES OF PATENTS.

Obtaining Spirits, &c., from Wood. Letters patent to William Edward Newton, sealed February 6, 1866, and dated August 31, 1865.

This invention consists in obtaining spirits of turpentine, rosin, tar, pitch, pyroligneous acid, gas, charcoal and wood, naphtha, directly from pine wood by one operation.

The wood containing the resinous gum (pitch pine wood) is placed in iron retorts, which are closed up steam tight, and a stream of steam is let into the retort, which may at the same time be heated externally to expedite the process. As soon as the condensation of the steam ceases or partially ceases, the pressure of steam in the retort rapidly forces the heat through the mass of wood until the heat reaches from 300° to 320° Fahrenheit, when the valve which connects the retort with a condenser is opened and the vapours containing water and spirits of turpentine pass over into the condenser and are condensed, the spirits rising on to the top of the water. This process continues several hours, the heat being gradually raised until the wood begins to char and forms acid, gas, and other products, at which time a large portion of the turpentine spirits have passed through the condenser. This process is hastened, and the yield of spirits in this part of the operation much increased, by reducing the pressure of the vapours in the retort to two or three pounds per square inch by the aid of air pumps and condensers, or otherwise. When the pressure is thus mainly removed, the evaporation is so rapid that without the use of superheated steam it is difficult to keep up sufficient heat without charring the wood in some parts, which must be avoided as long as possible, as the quality of the spirits is very poor after charring commences until they have passed through difficult processes of refining. While this process is going on rosin is formed and runs down to the bottom of the retort, and is drawn out before the charring commences.

In using the vacuum or partial vacuum in the distillation, it will be found advantageous to shut off the connexions of pump and condensers with the retort occasionally, to allow pressure of steam in the retort, which rapidly forces the heat through the wood again without charring it, unless the temperature of the steam is too high. The pressure of steam in the retort is not generally allowed to reach more than three or four atmospheres before it is again reduced. As soon as the yield of the spirits of turpentine becomes inconsiderable, the heat is raised and the charring commences, and as soon as this progresses rapidly, the steam may be nearly or quite shut off, and the acid formed will be much stronger than if the supply of steam be kept up during the entire distillation. The use of the vacuum or partial vacuum may be resorted to frequently throughout the entire distillation, the products coming over purer and at a much lower heat than they otherwise would. While the charring of the wood takes place the vapours passing off consist of acid, wood, naphtha, spirits, oil, tar, incondensable vapours, &c. A very advantageous way of separating the tar from the other vapours is to surround the condenser with a bath, heated to such a degree as to enable the vapours of the naphtha, acid, and spirits, together with the light oils, to pass through it without condensation, but cool enough to condense the tar, and so placed that the tar will run back into the retort while the vapours of the acid, naphtha, spirits, &c., pass on through another condenser, which may be cold, and separate the gas from the other products, or it may be heated sufficiently to carry the wood naphtha over with the gas into another condenser, where it is finally separated from the gas. The distillation is continued until the wood is thoroughly charred and the tar converted into a beautiful black lustrous pitch, the oils being nearly driven therefrom. Should the rosin be left in the retort, it will also be converted into pitch. Care should be used not to heat the retort too highly on the bottom, as the pitch will be destroyed, if heated too much, by turning it into coke. It should be watched and drawn out as soon as sufficiently hard, whatever be the heat of the retort bottom. Should neither steam nor superheated steam be used in the distillation, the retort should be closed tightly at first, and the steam formed from the water of the wood, and the other vapours, aid in increasing the pressure of vapours in the retort, and thus more equally distribute the heat through the wood. When the pressure in the retort reaches two or three atmospheres, the valve to the condenser may be opened.

Much more caution will have to be used to heat gradually and drive off most of the spirits before charring commences; if steam or superheated steam be not used to aid in heating the wood, these will be necessary if they are used.

Preparing Colouring Matters. By John Holliday. (This invention received provisional protection only.)

The nature of the said invention for "Improvements in preparing certain Colouring Matters" is as follows:—

"I take the dye usually known in commerce as 'cotton violet' (made from salts of rosaniline), of various violet tints, which dye is fugitive, rendering it valueless for dyeing wool, silk, and other fibres. I treat one part of this dye by adding to it about six parts of water, or it will act better if four ounces, more or less, of liquid ammonia sp.

gr. 0·880 be added thereto, though any alkali or salt of an alkali, such as common salt, may be used instead. This will cause the colouring matter previously in solution to be precipitated; this precipitate I wash with water, and place upon filters to dry. It is then in a fit state for sale; but I prefer to dissolve it in alcohol, so that it is fit for use direct into the dye bath. To render the colour purer, and vary the tint, I take the hereinbefore described precipitate and dissolve one part in from 8 to 16 parts methyl alcohol (wood naphtha), and when dissolved I add half a pound (more or less may be used) of sulphuric, muriatic, or nitric acid. This mixture I allow to stand some time, or I facilitate the operation by heating it to its boiling point a few minutes, and when cold this I again treat with alkaline water and precipitate, as above described. This latter operation may be repeated to advantage. I do not confine myself to the exact proportions or mode of operation herein above stated, as the same may be varied. In all cases I can recover the methyl alcohol (wood naphtha) by distillation from the liquid after the colour is precipitated."

Dyeing and printing Fabrics and Yarns. Letters patent to John Lightfoot. Sealed March 6, 1866, and dated September 11, 1865.

The object of this invention is to dye, print, or stain a fast black from aniline on wool, silk, feathers, or other animal substances or fabrics made from wool, and also fabrics made of a mixture of animal and vegetable substances, such as delaines and similar mixed goods.

"For mixed goods I wince or steep them in a solution of hypochlorite of lime, commonly known as chemick, or a mixture of hypochlorite of lime, hydrochloric acid, and water, for the purpose of preventing the deoxidising properties of the animal fibres and substances, thereby rendering them capable of receiving the aniline black, as described by me in the specification of a patent bearing date January 17, 1863, number 151.

"Although I have here named only hypochlorite of lime, I wish it to be understood that other similar oxidising agents will answer the purpose, such as hypochlorous and chlorous acids, hypochloric, chloric, and perchloric acids, or a solution of their salts of alkaline or metallic bases. Other oxidising acid salts, such as nitric acid, nitromuriatic acid, bichromate of alkalies, and permanganate of alkalies, will produce a certain effect; but I prefer, as more economical and of greater utility, the chlorine mixtures before described. When the wool or animal substance is thoroughly oxidised to its maximum, and in a fit state to receive the aniline black already named (by oxidation being understood the change, whatever it may be, that animal fibres undergo, when exposed to the substances described), it may be known by the following simple test:—Take a dilute solution of permanganate of potash in two test-tubes, and into one put a piece of the oxidised wool and into the other a piece that has not been oxidised, and apply a gentle heat; the solution containing the one that is in a fit state to receive the aniline black remains pinky, but the other is decolorised immediately.

"The proportions for preparing the wool are about as follows:—I take for every pound of cloth, wool, yarn, silk, delaine, feathers, or animal substance (well cleaned) six gallons of water at about 100° Fahrenheit, two and a half ounces by weight of hydrochloric acid of commerce, and one pint of hypochlorite of lime in solution, containing sixteen ounces of hypochlorite of lime per gallon. I keep the goods in this solution for from twenty to thirty minutes, or until the wool becomes quite yellow; I then wash well in water and dry.

"I am aware that woollen fabrics and fabrics of mixed wool and cotton have been previously steeped or prepared in mixtures containing chlorine or hypochlorous acid for the purpose of subsequently printing or dyeing such fabrics with ordinary colours not aniline black, but the chlorodising or oxidation sufficient for such purposes is not applicable to aniline black, and a point of oxidation or chlorodising is required which would not be advisable to give to fabrics intended for ordinary colours.

"In dyeing coburgs and similar goods the present processes involve two operations; firstly, the cotton has to be dyed, and then the wool or silk. I avoid this twice dyeing by preparing the mixture of cotton, wool, silk, or other animal substance as above, so that they will both take a black dye at one and the same time. I steep or pad the goods either before dyeing or after in the following dye:—One gallon of water, four ounces of chlorate of potash, twelve ounces of chloride of aniline crystals, six ounces of sal-ammoniac, two ounces of sulphate of copper. I then dry the goods at as low a heat as possible and age for two or three nights in a moist room at from about 76° to 80° Fahrenheit, and when the colour is thoroughly developed it becomes an intense myrtle green, almost black. I raise the goods either in water or any weak alkali, or in a weak cold solution of neutral chromate of potash, which I use in preference; and if a brownish black is required the goods may be subsequently dyed in a weak hot solution of archill or cudbear.

"When the prepared cloth is used for printing, I print on the aniline black colour as described in the specification of my former patent already referred to, and dry and age in a warm moist room, and raise in weak alkali as before. I then pass the goods through a warm solution of sulphite or hyposulphite of soda, or a solution of any suitable deoxidising agent, to improve the white or whites; or the goods may be passed through Mr. Thom's sulphuring apparatus, which restores the white in the parts not printed, but does not injure the black. It is preferable, after sulphuring, to repass the goods through a weak alkali."

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

1761. W. Stanfen, Barossa Place, Brompton, Middlesex, "Improvements in the treatment and application of vegetable fibres."—Petition recorded July 2, 1866.

1680. A. Lee, Bradford, "Improvements in preparing wool or other animal fibrous substances, yarns, and woollen fabrics for dyeing."—June 23, 1866.

1782. H. G. Fairburn, St. Luke's, Middlesex, "An improved process for forming and combining small coal or coal-dust into lumps, blocks, or otherwise, to be employed for the purpose of fuel."—July 5, 1866.

1789. J. A. Salmon, Liverpool, "Certain improvements in furnaces."—July 6, 1866.

1827. W. G. Walker, and R. F. Smith, Kilmarnock, N.B., "A certain improved method of producing illuminating gas."—July 12, 1866.

Notices to Proceed.

732. G. Phillips, Offord Road, Barnsbury, Middlesex, "Improvements in preparing purple and blue colouring matters."—Petition recorded March 10, 1866.

756. J. F. Bringes, Fieldgate Street, Whitechapel, "Improvements in machinery or apparatus for distilling bituminous shale and other bituminous substances of a like nature.—March 13, 1866.

779. T. G. Ghislin, Hatton Garden, Middlesex, "Improvement in the preparation of peat for the purpose of rendering it applicable to the manufacture of articles which are capable of being produced by stamping, moulding, embossing, or rolling."—March 15, 1866.

811. E. Field, Adelphi, Westminster, and F. Lloyd, Hoddesdon, Hertford, "Improvements in the mode of, and apparatus for, diffusing moisture and heat through vegetable or other matters."

812. T. Routledge, Ford Works, near Sunderland, T. Richardson, Newcastle-upon-Tyne, and W. H. Richard-

son, Jarrow-on-Tyne, "Improvements in treating the waste liquors resulting from the preparation of esparto grass, alfa straw, and other fibrous substances, and in purifying the alkali recovered therefrom, and in furnaces or evaporating pans connected therewith."—March 19, 1866.

827. W. E. Newton, Chancery Lane, "Improvements in the process of and apparatus for distilling petroleum and other mineral oils."—A communication from E. Braggins, M. P. Ewing, H. B. Everest, Rochester, New York, U.S.A.—March 20, 1866.

842. E. D. Elliot, Plymouth, "Improvements in treating animal charcoal used in refining sugar."—March 21, 1866.

1348. A. V. Newton, Chancery Lane, "Improved apparatus for manufacturing illuminating gas."—A communication from L. Stevens and N. C. Munson, Shirley, Mass., U.S.A.—May 10, 1866.

MISCELLANEOUS.

Bird's Method of Purifying Water.—Mr. Alfred Bird, of Birmingham, has patented the use of the neutral sulphate of alumina for purifying water. Its action depends upon the presence of carbonate of lime in the water to set free hydrated alumina, and as carbonate of lime is almost universally present the process is as universally applicable. The advantage of the use of this compound is, that beyond converting carbonate into sulphate of lime it introduces no new salt, while the organic matter is carried down with the hydrated alumina.

Gale's Protected Gunpowder Company (Limited).—The first ordinary meeting of the shareholders was held on Monday last. The report stated that the directors had found it desirable to erect crushing machinery at Bristol for the purpose of preparing the protecting material. These works are nearly completed, and will soon be in operation. The chairman (the Hon. H. W. Petre) moved the adoption of the report. What follows we extract from the *Standard*:—

"Mr. Rendle moved an amendment to the effect that a committee of five or seven shareholders be appointed to communicate with some eminent professors, such as Faraday, in order to ascertain the merits of Mr. Gale's discovery, and to report the result of their investigation to a future meeting.

"The meeting lasted three hours and a half, and in the course of the palaver the right of Mr. Gale to claim the merit of being the original inventor of this discovery was disputed. A more irregular meeting we never witnessed. Personalities formed the greater part of the discussion.

"The question of the amendment being put, there appeared, on a show of hands, two for the amendment and nine against it. The original motion was then put and carried."

Parliamentary Views of Infection.—In the course of a discussion on the Public Health Acts, the following extraordinary conversation took place. On clause 28, which relates to inspection by the medical officers,

Sir J. Jervoise thought the word "infection" which occurs in this clause ought to be defined. The medical officer, before surveying a house which was supposed to be infected, was recommended by the Committee of Privy Council to have on a particular dress, consisting of "strong water-tight boots, reaching to the knees, and greased all over (a laugh), a waterproof coat closely buttoned up to the neck and at the wrists, and the head covered with a cap which takes the hair well in." (A laugh.) He hoped the medical officer would be clothed in this safety dress before he embarked in the dreadful danger of visiting these nuisances, especially as he had to report to the nuisance authority; or, going into these pest-houses, he would himself come out pestiferous. (A laugh.) It was the more necessary that there should be a definition of "infection," from the visitation of cholera with which we were threatened. He had formerly asked a question on this subject, and referred to the fact that the Emperor of the French had been visiting the cholera hospitals in Paris. There was also the experiment mentioned in the newspapers of a young student, named Jerard, who, to show that cholera was not infectious, took the perspiration off the forehead of a dying man and the fur off his tongue, and put them in his own mouth. It was announced that the Emperor of the French had for the second time visited the cholera patients in the hospitals at Amiens. A commission which inquired into the ravages of the yellow fever at Bermuda reported that it was not infectious; and he could give a long list of similar conclusions respecting diseases that were supposed to be infectious.

Mr. Bruce would not argue whether cholera was or was not infectious. He presumed it would not be denied that there were diseases which were infectious, and if there were only one, whether it was small-pox, typhus, or any other disease, this clause ought to stand.

The first amendment made in the clause authorised the cleansing, not only of a house or part thereof, but "of any articles therein likely to retain infection."

Mr. Childers proposed to substitute for the words "the nuisance authority may" the words "it shall be the duty of the nuisance authority to" (cleanse and disinfect).

Mr. Walpole accepted the amendment, having intended to propose one similar to it.

Mr. Ayrton objected that this amendment would place a community at the entire mercy of "any legally qualified medical practitioner," on whose certificate the cleansing was to take place. It was a most monstrous proposition to invest "any legally qualified medical practitioner" with such domineering functions.

Mr. Bruce replied that the words "if it appear to the nuisance authority" (that cleansing would prevent infection) invested that authority with discretion.

The amendment was agreed to without a division.

On clause 29, giving the nuisance authority power to provide carriages for the conveyance of persons suffering from contagious diseases to a hospital, some discussion took place as to whether such provision should be made compulsory.

Mr. Powell moved to add the words, "Provided such carriage shall be disinfected."

Mr. Henley remarked that the House ought to be informed what disinfecting meant. The particular process to be used ought, in his opinion, to be specified in the Act. (Hear, hear.)

Mr. Bruce said the process of disinfection was perfectly well known at the hospitals.

Mr. Henley said that might be, but would the right hon. gentleman kindly inform the House what the method was? (Laughter.)

Sir Jervoise Jervoise pointed out that there were great doubts as to what was the most efficacious system of disinfection. A work recently published on the subject stated that one of the methods employed made matters worse than they were before. He thought it was desirable that the particular process to be made use of should be specified in the Act.

Mr. Walpole said that was a matter which might safely be determined by the authorities.

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. *Private* letters for the Editor must be so marked.

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THE

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AND

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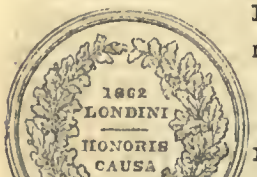

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Part III.

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Section III.—*Combinations of Multiple Radicals.*

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Let us take as examples these ethylenic compounds which we have just considered. The ethylene radicals possess the property of accumulating themselves in the polyethylenic alcohols, so as to form compounds belonging to more and more complicated types.

Type.	Type.	Type.
$\left.\begin{matrix}H_2\\H_2\end{matrix}\right\}O_2$,	$\left.\begin{matrix}H_2\\H_2\\H_2\end{matrix}\right\}O_3$,	$\left.\begin{matrix}H_2\\H_2\\H_2\\H_2\end{matrix}\right\}O_4$, &c.
$\left.\begin{matrix}(C_2H_4)''\\H_2\end{matrix}\right\}O_2$,	$\left.\begin{matrix}(C_2H_4)''\\(C_2H_4)''\\H_2\end{matrix}\right\}O_3$,	$\left.\begin{matrix}(C_2H_4)''\\(C_2H_4)''\\(C_2H_4)''\\H_2\end{matrix}\right\}O_4$.
Ethylenic alcohol.	Diethylenic alcohol.	Triethylenic alcohol.

In organic chemistry there exist hydrates which may be compared to the polyethylenic alcohols. According to the analyses of MM. Mitscherlich, Payen, and Mulder, plumbic hydrate—a well defined and crystallised body—contains $3PbO,HO$, which composition is expressed in our notation by the formula—

$$\left.\begin{matrix}Pb''\\Pb''\\Pb''\\H_2\end{matrix}\right\}O_4.$$

In this compound the diatomic atoms of lead and oxygen form a chain, to the extremities of which is attached the monatomic hydrogen; and it may be supposed that the atoms of oxygen are inserted between the atoms of lead, as we may admit that they are between the ethylene groups in the polyethylenic alcohols. (Vol. xiii., page 205.)

The normal stannic hydrate contains—

$$\left.\begin{matrix}\overset{iv.}{Sn}\\H_4\end{matrix}\right\}O_4.$$

By losing H_2O it is converted into another hydrate—or rather into a first anhydride—

$$\left.\begin{matrix}\overset{iv.}{Sn}\\H_2\end{matrix}\right\}O_3$$

which is stannic acid dried in vacuo, analysed by M. Fremy. The composition of the stannates is represented by the formula—

$$\left.\begin{matrix}\overset{iv.}{Sn}\\2R'\end{matrix}\right\}O_3.$$

According to M. Fremy, metastannic acid contains in its molecule 5 atoms of tin. When it has been dried at 100° its composition is expressed by the formula—

$$\left.\begin{matrix}\overset{iv.}{5Sn}\\H_{10}\end{matrix}\right\}O_{15}$$

The metastannates, which contain, according to M. Fremy,

$$\left.\begin{matrix}\overset{iv.}{5Sn}\\R_2H_8\end{matrix}\right\}O_{15}$$

correspond to this latter hydrate.

Silicium, tetratomic like tin, possesses also, like it, the property of becoming accumulated in those combinations which I have called *polysilicic*,† and which form a very large number of the complex silicates. The following may be considered the mode of generation of these compounds:—

Anhydrous silicic acid contains SiO_2. Its hydrate is—

$$\left.\begin{matrix}\overset{iv.}{Si}\\H_4\end{matrix}\right\}O_4$$

By losing H , it gives a first anhydride—

$$\left.\begin{matrix}\overset{iv.}{Si}\\H_2\end{matrix}\right\}O_3$$

But several molecules of silicic hydrate can unite and form, by losing water, a series of anhydrides intermediate in composition between the normal hydrated silicic acid and anhydrous silicic acid. We thus obtain series of polysilicic acids in which hydrogen may be replaced, completely or partially, by metals. These series are the following:—

Polysilicic compounds.

$$\left.\begin{matrix}Si\\H_4\end{matrix}\right\}O_4 \quad \left.\begin{matrix}Si_2\\H_8\end{matrix}\right\}O_{8+}^{+} \quad \left.\begin{matrix}Si_3\\H_{12}\end{matrix}\right\}O_{12} \quad \left.\begin{matrix}Si_4\\H_{16}\end{matrix}\right\}O_{16} \quad \left.\begin{matrix}Si_8\\H_{24}\end{matrix}\right\}O_{24}$$

* We have already shown how the atoms of oxygen are united together in perchloric acid (vol. xiii., p. 290). The number of them united together may be more or less great, thus forming with chlorine and hydrogen the whole series of the hydrated acids of chlorine. This series, as Laurent first showed, may be considered as formed, to some extent, by the oxidation of hydrochloric acid in the same way that the series of the phosphorus acids may be looked upon as resulting from the oxidation of phosphoretted hydrogen—

ClH Hydrochloric acid	PH_3 Phosphuretted hydrogen
$ClHO$ Hypochlorous acid	PH_3O Unknown
$ClHO_2$ Chlorous acid	PH_3O_2 Hypophosphorous acid
$ClHO_3$ Chloric acid	PH_3O_3 Phosphorous acid
$ClHO_4$ Perchloric acid	PH_3O_4 Phosphoric acid

Dr. Odling, who has investigated this subject, has, in fact, shown the formation of hypochlorous acid by submitting hydrochloric acid to the action of oxygen under the influence of platinum black.

Analogous series exist in organic chemistry—

C_2H_4 Ethylene	C_7H_6
C_2H_4O Oxide of ethylene (aldehyde)	C_7H_6O Hydride of benzoyl
$C_2H_4O_2$ Acetic acid	$C_7H_8O_2$ Benzoic acid (salic)
$C_2H_4O_3$ Glycolic acid	$C_7H_8O_3$ Salicylic acid
$C_2H_4O_4$ [?] Glyoxylic acid	$C_7H_6O_4$ Carbohydroquinonic acid
	$C_7H_6O_5$ Gallic acid

† *Répertoire de Chimie pure*, vol. ii., p. 449.

‡ The following considerations will show that all those polysilicic hydrates cannot exist in a free state. The first hydrate—

$$\left.\begin{matrix}Si\\H_4\end{matrix}\right\}O_4$$

can exist; tetratomic silicium can, in fact, unite with four monatomic groups $(HO)'$. But, in the hydrates which contain several atoms of silicium, part of the affinities of the silicium and the oxygen must be employed to join these atoms together, without which the molecular edifice would fall to pieces. The most probable supposition is to admit that the atoms of silicium are joined to each other by the atoms of oxygen. Now, to join n atoms of silicium, there must be $n-1$ atoms of oxygen. The latter deprive the silicium of $2(n-1)$ affinities; and if we subtract $2(n-1)$ from the sum of the affinities

$$\left.\begin{matrix}Si\\H_2\end{matrix}\right\}\Theta_3 \qquad \left.\begin{matrix}Si_2\\H_6\end{matrix}\right\}\Theta_7 \qquad \left.\begin{matrix}Si_3\\H_{10}\end{matrix}\right\}\Theta_{11} \qquad \left.\begin{matrix}Si_4\\H_{14}\end{matrix}\right\}\Theta_{15} \qquad \left.\begin{matrix}Si_6\\H_{22}\end{matrix}\right\}\Theta_{22}$$

$$\left.\begin{matrix}Si_2\\H_4\end{matrix}\right\}\Theta_6 \qquad \left.\begin{matrix}Si_3\\H_8\end{matrix}\right\}\Theta_{10} \qquad \left.\begin{matrix}Si_4\\H_{12}\end{matrix}\right\}\Theta_{14} \qquad \text{,,} \qquad \text{,,}$$

$$\left.\begin{matrix}Si\\(C_2H_5)_4\end{matrix}\right\}\Theta_4 \qquad \left.\begin{matrix}Si_2\\H_2\end{matrix}\right\}\Theta_5 \qquad \left.\begin{matrix}Si_3\\H_6\end{matrix}\right\}\Theta_9 \qquad \left.\begin{matrix}Si_4\\H_{10}\end{matrix}\right\}\Theta_{13} \qquad \left.\begin{matrix}Si_6\\H_{12}\end{matrix}\right\}\Theta_{18}$$

Tetrethylic silicate. Silicic hydrate of Fuchs.

$$\left.\begin{matrix}Si_3\\H_4\end{matrix}\right\}\Theta_8 \qquad \left.\begin{matrix}Si_4\\H_8\end{matrix}\right\}\Theta_{12} \qquad \text{,,} \qquad \text{,,}$$

Silicic hydrate of M. Fremy.

$$\left.\begin{matrix}Si\\2Mg''\end{matrix}\right\}\Theta_4 \qquad \left.\begin{matrix}Si_4\\H_6\end{matrix}\right\}\Theta_{11} \qquad \left.\begin{matrix}Si_6\\H_8\end{matrix}\right\}\Theta_{16}$$

Peridot

$$\left.\begin{matrix}Si\\2Si\end{matrix}\right\}\Theta_4 \qquad \left.\begin{matrix}Si_2\\{}^{vi}Al_2\\Ca''\end{matrix}\right\}\Theta_8 \qquad \left.\begin{matrix}Si_3\\H_2\end{matrix}\right\}\Theta_7 \qquad \left.\begin{matrix}Si_4\\{}^{vi}Al_2\\Na_2H_2\end{matrix}\right\}\Theta \qquad \left.\begin{matrix}Si_6\\{}^{vi}Al_2\\2Ca''\end{matrix}\right\}\Theta_{24}$$

Phenacite. Anorthite. Hydrate of Doveri. Analcime. Grossularie.

$$\left.\begin{matrix}Si\\2Zn''\end{matrix}\right\}\Theta_4 \qquad \left.\begin{matrix}Si_2\\Ca''\\H_4\end{matrix}\right\}\Theta_7 \qquad \left.\begin{matrix}Si_3\\2Mg''\\H_4\end{matrix}\right\}\Theta_{10} \qquad \left.\begin{matrix}Si_4\\{}^{vi}Al_2\\2K\end{matrix}\right\}\Theta_{12} \qquad \left.\begin{matrix}Si_6\\{}^{vi}Al_2\\6Fe''\end{matrix}\right\}\Theta_{24}$$

Willemite.

$$\left.\begin{matrix}Si\\{}^{iv}Zr\end{matrix}\right\}\Theta_4$$

Zircon. Okenite. Magnesite.§ Amphigene. Almandine (Oriental garnet).

$$\left.\begin{matrix}Si\\(C_2H_5)_2\end{matrix}\right\}\Theta_3 \qquad \left.\begin{matrix}Si_2\\Ca''\\Mg''\end{matrix}\right\}\Theta_6 \qquad \left.\begin{matrix}Si_3\\{}^{vi}Al_2\\Ca''\end{matrix}\right\}\Theta_{10} \qquad \left.\begin{matrix}Si_4\\{}^{vi}Al_2\\H_2\end{matrix}\right\}\Theta_{12} \qquad \left.\begin{matrix}Si_6\\{}^{vi}Al_2\\3Cl''\end{matrix}\right\}\Theta_{16}$$

Diethylic silicate. Diopside. Labradorite. Pyrophyllite. Emerald.

$$\left.\begin{matrix}Si\\Mg''\end{matrix}\right\}\Theta_3 \qquad \left.\begin{matrix}Si_2\\(C_2H_3)_2\end{matrix}\right\}\Theta_3 \qquad \left.\begin{matrix}Si_3\\{}^{vi}Fe_2\end{matrix}\right\}\Theta_9 + 12aq. \qquad \left.\begin{matrix}Si_4\\3Mg''\\H_2\end{matrix}\right\}\Theta_{12} \qquad \left.\begin{matrix}Si_6\\{}^{vi}Al_2\\K_2\end{matrix}\right\}\Theta_{16}$$

Enstatite. Diethylic disilicate. Chlorophæite. Talc. Orthose felspar.

It is clear that this theory allows us to conceive, and even to predict, the existence of innumerable silicates. Their constitution and the formulæ which represent them are not always very simple, and, in a large number of cases, cannot be so. One thing, however, is simple and rational—viz., their mode of generation, which is based on the one hand upon the principle of *the accumulation of the polyatomic radicals*, and on the other hand upon the *successive dehydration* which may be undergone by hydrates containing polyatomic radicals. These principles, which govern the constitution of a crowd of organic compounds, are susceptible of a great number of applications in inorganic chemistry and in mineralogy. We will give some new examples of them :—

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resulting in n atoms of silicium (that is to say, from $4n$), the difference $4n-2(n-1)=2(n+1)$ will express the affinities remaining in the chain of n atoms of silicium united by $n-1$ atoms of oxygen. The silicic hydrate, which is the richest in hydrogen, is therefore—

$$Si_n + \Theta_{(n-1)} + (H\Theta)_{2(n+1)}$$

If we make $n=1$, the trisilicic hydrate containing the greatest amount of hydrogen will be—

$$Si_3\Theta_2(H\Theta)_6 = \left.\begin{matrix}Si_3\\H_8\end{matrix}\right\}\Theta_{10}$$

The following formula expresses the mutual relations existing between the atoms of such a hydrate :—

$$\begin{matrix}Si-(H\Theta)_3\\|\\\Theta\\|\\Si-(H\Theta)_2\\|\\\Theta\\|\\Si-(H\Theta)_3\end{matrix}$$

§ Or, $\left.\begin{matrix}Si_3\\2Mg\end{matrix}\right\}\Theta_8 + 2\ aq\ (Aq = H_2\Theta)$.

We may similarly decompose the formulæ of okenite, pyrophyllite, analcime, talc, &c.

1st. Glycerine contains—

$$\left.\begin{matrix}(C_3H_5)'''\\H_3\end{matrix}\right\}\Theta_3$$

It may form, by losing $H_2\Theta$, glycide—

$$\left.\begin{matrix}(C_3H_5)'''\\H\end{matrix}\right\}\Theta_2$$

whose curious combinations were made known by M. Reboul.‖

The hydrates of aluminium, of iron, and their analogues may similarly suffer a partial decomposition—

$$\left.\begin{matrix}{}^{vi}Al_2\\H_6\end{matrix}\right\}\Theta_6 \qquad \left.\begin{matrix}{}^{vi}Al_2\\H_4\end{matrix}\right\}\Theta_4 \qquad \left.\begin{matrix}{}^{vi}Al_2\\H_2\end{matrix}\right\}\Theta_4 \qquad {}^{vi}Al_2\Theta_3$$

Gibbsite. Diaspore. Corundum.

$$\left.\begin{matrix}{}^{vi}Fe\\H_6\end{matrix}\right\}\Theta_6 \qquad \text{,,} \qquad \left.\begin{matrix}{}^{vi}Fe_2\\H_2\end{matrix}\right\}\Theta_4$$

Ferric hydrate. Goethite.

$$\left.\begin{matrix}{}^{vi}Mn_2\\H_2\end{matrix}\right\}\Theta_4$$

Manganite.

$$\left.\begin{matrix}{}^{vi}Ur_2\\H_2\end{matrix}\right\}\Theta_4$$

Uranic hydrate.

There exist salts corresponding to these different hydrates. Such are disthene and the spinels—

$$\left.\begin{matrix}{}^{vi}Al_2\\{}^{iv}Si\end{matrix}\right\}\Theta_3 \qquad \left.\begin{matrix}{}^{vi}Al_2\\Mg''\end{matrix}\right\}\Theta_4$$

Disthene. Spinel.

2nd. M. Lourenço¶ has shown that several molecules of glycerine may unite with elimination of water, and form polyglyceric combinations—

$$2\left[\left.\begin{matrix}C_3H_5\\H_3\end{matrix}\right\}\Theta_3\right] = \left.\begin{matrix}C_3H_5\\C_3H_5\\H_4\end{matrix}\right\}\Theta_6 + H_2\Theta.$$

Pyroglycerine.

$$2\left[\left.\begin{matrix}C_3H_5\\H_3\end{matrix}\right\}\Theta_3\right] = \left.\begin{matrix}C_3H_5\\C_3H_5\\H_2\end{matrix}\right\}\Theta_4 + 2H_2\Theta.$$

Pyroglycide.

$$3\left[\left.\begin{matrix}C_3H_5\\H_3\end{matrix}\right\}\Theta_3\right] = \left.\begin{matrix}3(C_3H_5)\\H_3\end{matrix}\right\}\Theta_7 + 2H_2\Theta.$$

$$3\left[\left.\begin{matrix}C_3H_5\\H_3\end{matrix}\right\}\Theta_3\right] = \left.\begin{matrix}3(C_3H_5)\\H_3\end{matrix}\right\}\Theta_8 + 3H_2\Theta.$$

The bodies thus formed constitute, in a manner, basic hydrates. Similarly limonite constitutes a basic ferric hydrate—

$$2\left[\left.\begin{matrix}{}^{vi}Fe_2\\H_6\end{matrix}\right\}\Theta_6\right] = \left.\begin{matrix}{}^{vi}2Fe_2\\H_6\end{matrix}\right\}\Theta_8 + 3H_2\Theta.$$

Limonite.

It is evident that in such hydrates the basic hydrogen may be replaced by radicals of acids. We thus obtain basic salts, of which the polyethylenic and polyglyceric ethers are the representatives in organic chemistry, and of which very numerous examples are known in inorganic chemistry.

Let us first take the constitution of the basic ethers in question—

$$\left.\begin{matrix}C_2H_4\\C_2H_4\\(C_2H_3\Theta)_2\end{matrix}\right\}\Theta_3 \qquad \left.\begin{matrix}C_2H_4\\C_2H_4\\C_2H_4\\(C_2H_3\Theta)_2\end{matrix}\right\}\Theta_4 \qquad \left.\begin{matrix}C_2H_4\\C_2H_4\\C_2H_4\\C_2H_3\Theta\\H\end{matrix}\right\}\Theta_4$$

Diethylenic diacetate. Triethylenic diacetate. Triethylenic monacetate.

‖ *Annales de Chimie et de Physique*, 3rd series, vol. lx., p. 5, 1860.
¶ *Comptes Rendus*, vol. lii., p. 369.

It is evident that the basic acetates of lead and copper are the analogues of these ethers—

$$\left.\begin{matrix}Cu''\\Cu''\\(C_2H_3\Theta)_2\end{matrix}\right\}\Theta_3+3aq. \qquad \left.\begin{matrix}Cu\\Cu\\Cu\\(C_2H_3\Theta)_2\end{matrix}\right\}\Theta_4$$

Dicupric diacetate.** Tricupric diacetate.

$$\left.\begin{matrix}Pb\\Pb\\Pb\\(C_2H_3\Theta)_2\end{matrix}\right\}\Theta_4+3aq. \qquad \left.\begin{matrix}Pb\\Pb\\Pb\\C_2H_3O\\H\end{matrix}\right\}\Theta_4.$$

Triplumbic diacetate. Triplumbic monacetate (called sexbasic acetate).

(To be continued.)

The Formation of the Secondary Monamines of the Phenylic and Toluylic Series, by MM. G. DE LAIRE, CH. GIRARD, *and* P. CHAPOTEAUT.*

IN 1864 Dr. A. W. Hofmann discovered diphenylamine and phenyltoluylamine whilst examining the products of the dry distillation of rosaniline and phenylic and toluylic blues; since then he has obtained diphenylamine by decomposing leucaniline and melaniline by heat. But in these instances the diphenylamine and the phenyltoluylamine only appear as the products of the destruction of higher phenylic and toluylic amines.

Numerous experiments have been undertaken to determine the synthesis of these interesting bodies, but without success. M. Lauth, with this intention, made monobromobenzine and also acetate of phenyle react upon aniline. These experiments gave no result; we have also repeated them, but with as little success.

We recollect that in 1860, whilst heating some salts of rosaniline with an excess of aniline, we obtained a blue colouring matter, and an escape of ammonia proportioned to the quantity of blue formed.

In 1863 Dr. A. W. Hofmann interpreted this curious reaction, and formulated it thus—

$$\left.\begin{matrix}C_{12}H_4H\\C_{14}H_6H\\C_{14}H_6H\end{matrix}\right\}N_6+3\left\{\begin{matrix}C_{12}H_5\\H\\H\end{matrix}\right\}N=\left.\begin{matrix}C_{12}H_4,C_{12}H_5\\C_{14}H_6,C_{12}H_5\\C_{14}H_6,C_{12}H_5\end{matrix}\right\}N_3+3\left\{\begin{matrix}H\\H\\H\end{matrix}\right\}N.$$

In a moderately high temperature three equivalents of phenylamine react upon the salt of rosaniline, and phenyl becomes substituted for the hydrogen, equivalent for equivalent.

Noticing this facility of substitution, we surmised that, by the action of aniline on its salts, diphenylamine and ammonia might be produced.

$$\left.\begin{matrix}C_{12}H_5\\H\\H\end{matrix}\right\}N+\left.\begin{matrix}C_{12}H\\H\\H\end{matrix}\right\}N=\left.\begin{matrix}C_{12}H\\C_{12}H\\H\end{matrix}\right\}N+\left.\begin{matrix}H\\H\\H\end{matrix}\right\}N.$$

Experiment confirmed this supposition, and we have the honour of placing before the Academy the result of our researches.

We made aniline react on several of its salts—the sulphate, hydrochlorate, nitrate, arseniate, phosphate—and on the combinations this base forms with the chlorides of zinc, tin, calcium, and mercury. In each case there was disengagement of ammonia, with the production of a greater or less quantity of a matter which perfectly agreed both in its analysis and its various reactions with the formula of diphenylamine $C_{24}H_{11}N$, and the excellent description of it given by Dr. A. W. Hofmann.

Of all the salts of this base hydrochlorate of aniline seems to us best adapted for the purpose of substitution.

Diphenylamine.—In a long-necked flask, furnished with a condensing tube to avoid the loss of any of the aniline, we heat one and a half equivalent of pure aniline with one equivalent of its hydrochlorate to a temperature between 210° and 240°; the diphenylamine begins to form when this temperature is reached, and the commencement of the reaction is indicated by the escape of ammonia; by prolonging the operation thirty or thirty-five hours, an amount of diphenylamine is obtained, which may equal the fifth part of the aniline employed.

The formation of diphenylamine takes place more rapidly and in larger quantity in a sealed vessel and under a pressure of from four to five atmospheres.

In each case the product of the experiment is a compound of hydrochlorate of diphenylamine, hydrochlorate of aniline, some free aniline, and some colouring matters varying in quantity according to whether the operation is performed in an open or closed vessel.

To extract the diphenylamine from this mixture, it must be treated by hydrochloric acid and warm water (twenty or thirty times the weight of the acid); the hydrochlorate of diphenylamine being decomposable by water, the fused base floats on the surface, and forms a mass on cooling. The purification is accomplished by several successive crystallisations from ether or benzine; as the colouring matters are insoluble in these liquids, a single distillation yields a white matter with a boiling-point of 310°.

Ditoluylamine.—Toluidine, being the homologue of aniline, behaves in all its reactions like it, and, therefore, ought to give us its secondary monamine by reacting on its hydrochlorate. The operation is conducted in the same manner, and the conditions of the formation are the same, as in the case of diphenylamine. We have escape of ammonia, then, as the final result of the experiment, a compound of hydrochlorate of the new base, of hydrochlorate of toluidine, of free toluidine, and of some colouring matters.

In dealing with this raw matter, the treatment already employed for diphenylamine must be used—that is to say, hydrochloric acid, water, then several successive crystallisations in ether to separate the colouring matters.

The purified base is solid, crystallised, and perfectly white; its boiling-point is between from 355° to 360°. Several combustions gave us the following formula, which is that of ditoluylamine—namely, $C_{28}H_{15}N$.

The reactions of this new body are very analogous to those of diphenylamine. Like diphenylamine, it combines with acids and produces very unstable combinations, which, on contact with water, separate into their principal constituents.

When nitric acid is poured over the crystals they turn yellow, by which this base may be distinguished from diphenylamine.

Phenyltoluylamine.—This base, which Dr. A. W. Hofmann has already obtained by distilling the toluidine blue, ought to be produced during the reaction of aniline on hydrochlorate of toluidine, and of toluidine on hydrochlorate of aniline. The experiment is performed as though it were for the production of diphenylamine or ditoluylamine. The treatment already followed for the extraction of these two bases from the raw product, hydrochloric acid, water, and several crystallisations in ether, gives us a perfectly white base.

In the reaction of aniline on hydrochlorate of toluidine, and still more in that of toluidine on hydrochlorate of aniline, the purified product is a mixture of diphenyl-

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** It is possible that this salt may be a monocupric monacetate—

$$\left.\begin{matrix}Cu\\(C_2H_3\Theta)'\\H\end{matrix}\right\}\Theta_2+H_2\Theta.$$

* *Comptes Rendus*, t. lxiii., p. 91.

amine, phenyltoluylamine, and ditoluylamine. In order to isolate respectively these three bases, we have been forced to make use of fractional distillation; their separation is as difficult as that of aniline from toluidine, their boiling-point only differing from about 25° to 30°. The boiling-point of pure phenyltoluylamine is about 330°. Analysis gives it this formula—$C_{26}H_{13}N$.

We have already stated that the operations performed in a closed vessel occupy much less time than those performed in an open one; but in both cases, if the operation lasts too long, the quantity of secondary monamines is diminished. Bodies are produced, probably the tertiary monamines of aniline and toluidine, with boiling-points exceeding any temperature observable with mercurial thermometers.

TECHNICAL CHEMISTRY.

On the Employment of Nitroglycerine in Quarries, by M. E. Kopp.*

The explosive properties of nitroglycerine $C_6H_5(NO_4)_3O_6$, and the accounts of experiments made with it in different parts of Sweden, Germany, and Switzerland, determined MM. Schmitt and Dietsch, the proprietors of the great quarries of sandstone in the valley of Zorn, Lower Rhine, to try to use it in their works.

The trial proved so successful, both as regards economy and the ease and rapidity with which the work was performed, that, for the time at least, they have abandoned the use of powder, and the quarries have been entirely worked by nitroglycerine for six weeks.

From the first we have considered that the nitroglycerine should be prepared on the spot; it always seemed to us the transport of an explosive compound of such frightful power ought not to be allowed either by land or water. The terrible accidents which have happened at Aspinwall and at San Francisco, justify these fears, and the transport of nitroglycerine should be positively forbidden.

After having, with M. Keller's assistance, studied in my laboratory the different processes of the preparation of nitroglycerine (mixtures of glycerine with concentrated sulphuric acid and nitrates of potash and soda or with nitric acids of different concentrations), we have determined on the following method of manufacture, which is performed in a wood cabin, constructed in one of the quarries.

I. Preparation of Nitroglycerine.—We begin by mixing in an earthenware vessel placed in cold water some fuming nitric acid at 49° or 50° Baumé (1·51—1·53) with twice its weight of the strongest sulphuric acid. These acids are purposely prepared at Dieuze, and sent on to Saverne. At the same time we evaporate in a pot some commercial glycerine free from both lime and lead, until it makes 30° or 31° Baumé (1·26—1·27). This concentrated glycerine should, after cooling, have a syrupy consistence.

The workman then throws 3300 grammes of a mixture of sulphuric and nitric acids well cooled into a glass flask (a pot of earthenware or a capsule of porcelain might equally be employed) placed in a trough of cold water, and then he slowly pours into it, stirring it continually, 500 grammes of glycerine. The thing to be observed is the avoidance of any sensible heating of the mixture, which would determine a tumultuous oxidisation of the glycerine and the production of oxalic acid. For this reason it is that the vessel in which the transformation of the glycerine into nitroglycerine takes place, should be constantly cooled externally by cold water.

When the materials are thoroughly mixed, the whole must be left for five or ten minutes; then pour the mixture into five or six times its volume of cold water, to which a rotatory movement must first be imparted. The nitroglycerine precipitates very rapidly under the form of a heavy oil, which is collected by decantation into a vessel; then wash it with a little water which is in its turn decanted, pour the nitroglycerine into bottles, and it is ready for use.

In this state, the nitroglycerine is still slightly acid and watery; but this is of no importance, since, as it is employed soon after its preparation, these impurities in no degree prevent detonation.

II. Properties of Nitroglycerine.—Nitroglycerine is a yellow or brownish oil, heavier than water and insoluble in it, but soluble in ether, alcohol, &c.

Exposed to a prolonged but not intense amount of coldness, it crystallises in long needles. A violent shock best causes it to detonate. The handling of it is now easy and only slightly dangerous. Spread upon the ground it is only with difficulty fired by a body in combustion, and then only burns partially; a flask containing nitroglycerine may be broken upon stones without its detonating; it may be volatilised without decomposition by a regulated heat, but if it boils, detonation becomes imminent.

A drop of nitroglycerine falling on a metal plate moderately heated volatilises quietly. If the plate be red-hot, the drop is immediately fired and burns like a grain of powder, only noiselessly; but if the plate, without being red-hot, is hot enough to make the drop boil immediately, it decomposes suddenly with a violent detonation.

Nitroglycerine, especially when impure and acid, decomposes spontaneously after a certain time, with an escape of gas and the production of oxalic and glyceric acid.

Probably the spontaneous explosions of nitroglycerine, with whose disastrous effects the papers have acquainted us, are owing to the same cause. The nitroglycerine being enclosed in well-corked bottles, the gases produced by its spontaneous combustion cannot escape; they then exercise an immense pressure on the nitroglycerine, and in this state the least shock and the slightest movement will cause an explosion.

The flavour of nitro-glycerine is at once sweet, piquant, and aromatic; it is poisonous, and taken in small doses it produces bad headaches. Its vapour produces similar effects, and this reason might well prove an objection to its use in the subterranean galleries of mines, where its vapours cannot disperse as they do in open-air quarries.

Nitroglycerine is not, properly speaking, a nitrated body, such as nitro- or binitro-benzol, or mono- bi- and trinitro-phenisic acids. Indeed, under the influence of reducing bodies, such as nascent hydrogen, sulphuretted hydrogen, &c., the glycerine is set at liberty, and the caustic alkalies decompose the nitroglycerine into nitrates and glycerine.

III. Modes of employing Nitroglycerine.—Suppose the object is to detach a stratum of rocks. At 2·50 to 3 metres distance from the exterior border sink a mining hole about 5 or 6 centimetres in diameter and 2 or 3 metres in depth.

After having thoroughly cleared all mud, water, and sand out of the hole, pour into it, through a funnel, from 1500 to 2000 grammes of nitroglycerine. Then immerse

* *Comptes Rendus*, t. lxiii., page 189.

in it a little cylinder of wood, pasteboard, or tin, about 4 centimetres in diameter, and from 5 to 6 centimetres in height, and filled with ordinary powder. This cylinder is fixed to an ordinary mining fuse, which goes down a certain depth to insure the combustion of the powder. The cylinder is lowered by means of the wick or fuse; the moment the cylinder reaches the surface of the nitroglycerine, may easily be known by the touch. When it touches the surface, hold it perfectly still, and pour sand into the hole until it is quite full; there is no need to compress or plug the sand. Cut the wick some centimetres from the orifice of the hole, and then set fire to it. In about eight or ten minutes the match burns down to the powder and fires it. Then ensues a violent shock, which immediately causes the detonation of the nitroglycerine. The explosion is so sudden that the sand is not even projected.

The whole mass of the rock rises, is displaced, then resettles without any projection; only a dull detonation is heard.

Only on examining the spot can an idea be formed of the power of the force developed by the explosion. Formidable masses of rock are slightly displaced and rent in every direction, and ready to be removed mechanically.

The chief advantage is that the stone is only slightly crushed, and there is very little waste.

In the manner we have shown, from 40 to 80 cubic metres of rock may be detached by charges of nitroglycerine.

We trust to have shown by this notice the possibility of reconciling the employment of nitroglycerine with every desirable guarantee for public safety.

PROCEEDINGS OF SOCIETIES.

ROYAL SCHOOL OF MINES, MUSEUM OF PRACTICAL GEOLOGY.

A Course of Twelve Lectures on Chemical Geology, by Dr. Percy, F.R.S.

Lecture No. VII.

(Continued from page 57.)

There is one peculiar kind of decomposition, or one singular example of it, to which I must invite your attention—namely, that of the sulphide of silver. Here we have a grey compound consisting of sulphur and silver. If I take those two bodies and melt them together, which I can easily do, they combine, producing this dark grey compound. This is the same stuff which forms the well-known tarnish of silver, which occurs especially in an atmosphere impregnated with animal emanations, as London and elsewhere. Now, if we take this sulphide of silver (AgS), and heat it in a glass tube to a moderate temperature, and then pass steam, the vapour of water, over it, we effect a complete reduction; we remove the whole of the sulphur and obtain the silver in the metallic state. We do not here get oxidised silver. There is no doubt the silver is oxidised first of all, but that oxide is immediately decomposed, because oxide of silver cannot exist even at a red heat. It is decomposed even at the temperature which suffices for the decomposition of the sulphide by means of the steam. Again, if we pass hydrogen over sulphide of silver at a red heat, we can remove the whole of the sulphur, and leave the silver in a metallic state. Well, what is the point of this? It is this: in nature we find that well-known and beautiful ornament of our cabinets—capillary silver. Now, if we reduce sulphide of silver, by the means I have described, at a red heat, we get the metallic silver left precisely in this capillary state. I will effect the decomposition of some sulphide of silver, but I do not intend to do it by means of the vapour of water, as there would be danger of the tube cracking. I will do it by means of hydrogen gas. We are about to liberate hydrogen gas from this flask by means of the action of diluted sulphuric acid upon zinc, and then pass it into a tube containing sulphide of silver. The silver is precipitated, and the gas becomes converted into sulphuretted hydrogen—that fœtid gas which has the odour of rotten eggs. The sulphuretted hydrogen passes on into the adjoining vessel, which contains a salt of lead in solution. The solution is immediately blackened, the lead being precipitated by the sulphur of the sulphuretted hydrogen. Thus we take the sulphur from the silver by means of hydrogen gas, and then we take the sulphur from the hydrogen by means of lead. It is impossible for me to render this fully manifest to you at a distance, but after the lecture you will have an opportunity of inspecting the changes for yourselves. Here are specimens we have prepared presenting beautiful illustrations of the formation of capillary silver in nature. It is suggested by Bischoff that steam has been the agent of the production of this natural capillary silver. A good deal may be said about this matter. We get a similar formation in copper-smelting operations—hair copper, or moss copper, as it is called. Here are specimens, but you will have to examine them with a small lens in order to detect the formation to which I allude. Of course in nature we find very much larger threads than those which I present to you now; that, as usual, is merely a question of time.

Now as to the spontaneous decomposition of some of these sulphides. You will observe that I am dealing with these points now in a most general way, reserving certain specialties for the sequel. Some of these sulphides undergo spontaneous decomposition. One of the best examples is that of iron pyrites, to which I shall invite your special attention directly, as a compound of sulphur and iron in the proportion of one equivalent of iron to two of sulphur. There are well-known crystallographic varieties of that mineral. There is one called white iron pyrites, crystallising in the prismatic system; and there is cubical iron pyrites, crystallising in the cubical system. This it is which is more especially liable to spontaneous decomposition. It becomes oxidised by exposure to moist air; and when it occurs in masses, and is subjected to oxidation in this way, sufficient heat is sometimes generated by the action to ignite surrounding carbonaceous matter. There is no doubt that spontaneous ignition in coal mines has in many cases been due to the heat developed by the slow oxidation of this pyrites. Then as the result of the oxidation, or weathering action, we get certain sulphates of iron—sulphates of the peroxide of iron, several of which occur in nature, and very beautiful, though not very common, minerals they are. We have very fine specimens of some of these sulphates from South America. One of the best examples I can mention is the sulphate resulting from the weathering of these sulphides in coal measures. We shall see that all coal contains iron pyrites, without exception. I think I may state that without fear of contradiction. The pyrites undergoes decomposition by moist air, forming a sulphate of peroxide of iron, of a yellow colour. This is a very important matter, because upon the weathering action often depends the disintegration of coal, and coal which is subject to such disintegration is entirely unfit for steam purposes. It is, therefore, an object to get a coal free from disseminated pyrites to any extent for such use. As another result of weathering action, or oxidation by moist air, I will call your attention to a very beautiful mineral first got in the island of Anglesey, and hence called anglesite. It is a sulphate of lead. In South America some specimens of this have been found, perhaps the finest in the world. Now, there is no difficulty in understanding how we should get sulphate of lead by the oxidation of sulphide of lead. This is an ore of lead, galena, a compound of

lead and sulphur. The chemical symbol for lead is Pb, from the Latin *plumbum*. Sulphide of lead is therefore represented by PbS. Sulphate of lead is nothing more than oxide of lead (PbO) and sulphuric acid (SO_3), using the old method of notation to which I adhere in these lectures. You see that by a simple addition of oxygen to these elements PbS, which represent sulphide of lead, you get the mineral in question, $PbOSO_3$, which is sulphate of lead. Sulphate of lead has been found very largely in an ore in Australia. They are receiving hundreds of tons of it at a smelting works in South Wales, the lead existing entirely as sulphate.

There is another point of interest which comes in here. On lead ore which has been exposed to weathering action and oxidised, we find not only sulphate of lead, but carbonate of lead. How are we to account for this carbonate of lead being formed as a result of weathering action? How can we explain the carbonic acid? Well, on thinking on this matter we soon come to the conclusion that there must be a secondary action at work here; and there is a *vera causa* quite ready at hand, which explains the thing at once. In mineral lodes and veins, where this action takes place, there is often water percolating containing carbonate of lime in solution, dissolved by virtue of an excess of carbonic acid. Now, galena frequently occurs in limestone formations, and when we see a piece of carbonate of lead, or white lead, on a piece of galena, that is clearly the result of weathering action, and you may be quite sure that sulphate of lead has been first formed, and has been, perhaps, decomposed, *pari passu*, by the carbonate of lime in the water. We get, then, the conditions under which carbonate of lead may be formed. Sulphate of lead, we know, is immediately decomposed by the action of carbonate of lime, and therefore we are left in no doubt as to the way in which we can account for the natural mineral carbonate of lead.

The formation of the sulphides is a subject of very great interest. We can form them directly in many cases, but not all, by heating sulphur and the metal together. We could not form sulphide of gold in this way, because that compound is decomposed by a gentle heat; but the sulphides of all the metals combining with sulphur we can obtain either directly or indirectly. Here is disulphide of copper, ruthite, obtained by treating the metal with sulphur. We can, in fact, form iron pyrites by an aqueous process, but only at a low temperature and under special conditions. Here is a small specimen of iron pyrites so formed. The crystals are distinct, though their form cannot be recognised except under a magnifying glass. It is formed by a special process; but more of that hereafter. It is a process described by Wöhler, and discovered by him. Here is a sample of bisulphide of tin.

We get sulphides formed in nature by a sort of roundabout way. For instance, there is the beautiful mineral pyromorphite or phosphate of lead, which we find completely converted into sulphide of lead. We know that this conversion has taken place, because such sulphide of lead has the crystalline form of the phosphate of lead, and not that of the sulphide. It has been formed by the action of a sulphur compound upon phosphate of lead, and that compound must be one of two—either a sulphide or a sulphate.

Let us take for special consideration that most interesting sulphide—interesting in the highest degree to the geologist—the bisulphide of iron, iron pyrites. This is composed of one equivalent of iron and two of sulphur, FeS_2. When heated in a close vessel it loses about half its sulphur—not exactly, *about* half, I say; and it then forms very nearly a protosulphide of iron, but not quite. It occurs in nature beautifully crystallised in the cubical system—either in cubes, sometimes of large dimensions, and striated in a curious way, or in some figure derived from the cube. In this form it is known as common yellow iron pyrites. It also crystallises in the prismatic system. There are specimens of both forms before you. Heated with access of air it burns, and when ignited will continue to burn without the further addition of fuel. Sulphurous acid is produced — the sulphurous acid of commerce, which plays so large a part in the history of the world, for all soap is produced by means of it from chloride of sodium, common salt. There is in connexion with the subject of iron pyrites a piece of history which shows what curious mistakes may be made by monarchs. A great many years ago we were very much troubled by the late King of Naples, who possessed a monopoly of sulphur, putting on high prohibitory duties on sulphur exported from his territory. At that time sulphuric acid was made almost entirely from native sulphur obtained from Naples and elsewhere. Well, our people were determined, of course, not to submit to this restriction, and it immediately occurred to chemists that iron pyrites might be a very valuable source of sulphur. Means were taken for its extraction, and this bisulphide of iron has now become the chief source of sulphur for the manufacture of sulphuric acid, or a very large source at all events. You see, people may sometimes outwit themselves in matters of this kind. There is only one drawback to the use of the sulphur of the pyrites: that is it contains not unfrequently a little arsenic, and, of course, that arsenic will get into the sulphuric acid, or it may get there.

Now as to the mode of formation of bisulphide of iron in nature, or, rather, as to the conditions under which it may have been formed. First of all, its association with certain minerals proves to us, in the clearest and most unmistakable manner possible, that it may be formed—nay, *has been* formed very largely—in the wet way, that is, by the agency of liquids, in some way or other, from solutions, without the aid of intense heat. Take this little specimen. How apparently insignificant it is! It is nothing more than a little bit of clay iron ore. Well, what is clay iron ore? Nothing more than carbonate of protoxide of iron mixed with certain other bodies. It is the chief ore of iron in this country, and one occurring especially in our coal measures. Well, we may take a lump of it, break it open, and find a concretion in the centre consisting of a cube of iron pyrites. Now, from certain considerations we are perfectly sure that this carbonate of iron must have been produced from liquids or from solution. It cannot exist at a high temperature. Well, in the centre of this globule we find iron pyrites. I think that can leave no doubt of the fact of the pyrites being formed by the action of water, or, at all events, by the agency of liquids. Well, here is another specimen of common clay iron ore coated with carbonate of iron, and upon these delicate crystals of carbonate of iron I find iron pyrites deposited. We are perfectly certain that the pyrites must have been produced by the agency of liquids, because the carbonate of iron upon which it is found cannot exist at a high temperature. Of that we are perfectly certain. Further, Bischoff tells us that iron pyrites has actually been obtained crystallised artificially from solutions. There is a well-known experiment, or the result of one, very often mentioned in works on chemical geology. I allude to the formation of iron pyrites upon the remains of an unfortunate mouse which happened to tumble into a bottle of sulphate of iron. The animal matter suffered decomposition; certain gaseous sulphurous products were evolved, and by the agency of them sulphide of iron was formed. We have tried to imitate that, but unfortunately the experiment failed. The process was allowed about three years, but the air got access. There seems to be no doubt, however, about the story told by Bischoff. Well, then, here are two kinds of proofs of the production of iron pyrites in the wet way. There is the direct laboratory proof of the formation of it in that way, and there is the indirect proof, if I may call it such—though it is rather direct than otherwise—of the

occurrence of this bisulphide of iron with certain mineral matters which never could have been exposed to a high temperature. I may mention these specimens, of which you will find a large quantity at the base of the cliff at Eastbourne. They drop out occasionally from the cliff. They are nodules of iron pyrites.

With regard to the possibility of the occurrence of conditions suitable to the formation of iron pyrites in nature, I will draw your attention hereafter to certain cases put forward by Bunsen. We find in the laboratory that in certain alkaline solutions, when there is a large excess of bisulphide of potassium or sodium, we sometimes get a dark green solution. That is due to a sulphide of iron, apparently dissolved in the alkaline sulphide. In the formation of ultramarine, after washing the product with water, we get this green solution, which lets fall, on standing, bisulphide of iron. No doubt, in the first instance, this was entirely dissolved. Now comes the question, whether in nature we might not meet conditions exactly similar to this, whereby bisulphide of iron may have been generated. There are strong reasons to believe we may.

There are many other sulphides of great interest, but we must pass over them pretty rapidly.

I will next call your attention to another combination of sulphur and iron, magnetic iron pyrites, which occurs rather abundantly in nature, at least in some places. Here is a specimen of it—Norwegian iron pyrites. It occurs in Norway to a large extent. We have it also in Argyle in Scotland. It does not often occur well crystallised. It consists of seven equivalents of iron and eight of sulphur, Fe_7S_8. Or you will find that it can be represented by six equivalents of protosulphide of iron and one equivalent of bisulphide. Suppose we regard it as such—

$$6FeS + FeS_2.$$

I do not for a moment mean to assert that the elements are actually combined in this magnetic pyrites as they are represented in the last formula. All I mean to say is, that by that formula we may represent its rational composition. The chief interest in connexion with this sulphide is the occurrence of sulphide of nickel with it, and accordingly, as nickel is a valuable metal, constituting the whitening agent in the well-known variety of brass called German silver; this magnetic pyrites is a valuable ore, and has been largely worked for the sake of its nickel, though not to the extent that some people may desire. We have the occurrence of nickeliferous pyrites in Scotland. The quantity of nickel varies from two or three to about seven per cent. I call your attention to this fact more particularly because, should any person present, in travelling in different parts of the world, stumble upon magnetic iron pyrites, it is worth while to search for the presence of nickel in it.

The next natural sulphide of which I will speak is galena, sulphide of lead. You have here very fine specimens before you. I have already referred to some of its properties. Sulphide of lead crystallises in the cubical system. It is frequently met with in fine cubes, or in some modification of the cube. We can form it directly by the agency of fire. You see there a specimen of sulphuret of lead beautifully crystallised. You may have mistaken it for bismuth. We can obtain it well crystallised by the operation of heat. I told you that in certain furnace operations I have seen it deposited in the form of crystals, and in roasting furnaces you see it deposited on the surface of the roasting ore. But there is also no doubt whatever that sulphide of lead may be produced crystallised by aqueous action. We can generate it fast enough by passing sulphuretted hydrogen into a salt of lead in solution. The sulphuretted hydrogen becomes decomposed, hydrogen is set free, and sulphide of lead is formed. Take that brownish powder, the sulphide of lead, which is formed: now, can we crystallise that by means of a solvent, or, rather, can Nature do so? Our powers of operating are very limited. We can only use our hands, mixing one substance with another—our power is limited to that. But when we by our spontaneous action have brought the different bodies together, then Nature does her work. Well, here is a specimen of clay iron ore which we know has been deposited from water; and in the centre of that is a lump of galena. I have seen beautifully crystallised masses of this galena in common coal, occurring at Bedworth in Warwickshire. These two specimens alone would render the conclusion perfectly certain that sulphide of lead may be obtained crystallised from solution. There is no doubt whatever on the subject. When we examine mineral lodes too—that is, those cracks in the earth which have been filled up by metalliferous veins—we frequently see galena forming beautiful ribs and strings of crystals; and we are perfectly certain, from the association of other minerals and the conditions under which it is found, that in many cases it has been thrown down crystallised from water. Some persons have supposed that it has arisen in vapour deep down from the bowels of the earth, and been deposited in crystals as we find it; but if you will take the trouble to examine some of the specimens, and especially the associated minerals, you will be perfectly convinced that in many instances it must have gone down from water. It cannot have been deposited from vapour in the way suggested, because the bottom of the lode sometimes contains none of the mineral, but has some other substance there. I do not say that that is so in every case, but it is so in some, and where it occurs it shows clearly that the lead must have gone down from the top, and not have come up from below.

We shall resume our examination of the sulphides in the next lecture.

ACADEMY OF SCIENCES.

July 30.

M. Lionnet presented a note "*On the Natural and Artificial Production of Crystallised Carbon.*" Many persons besides the author of this note have occupied themselves with the endeavour to obtain diamonds by the decomposition of sulphide of carbon. But M. Lionnet's method is peculiar. He takes a sheet of platinum-foil, and a sheet of tin-foil of rather smaller dimensions, and rolls them together loosely. The roll so made he places in a bath of sulphide of carbon. A feeble electric current, the author says, is then set up, the sulphide of carbon is decomposed, the sulphur combines with the tin, and the carbon gathers in crystals which fall to the bottom of the vessel. Time is, of course, required to obtain large crystals!

M. Gernez presented a note "*On the Phenomena of Super-fusion.*" The author, it will be remembered, made the discovery that super-saturated solutions of salts crystallised immediately on contact with a solid particle of the substance in solution, and that no other substance would provoke the crystallisation. The discovery now announced is of a similar character. Phosphorus fuses at 44° C.; but it is well known that with a little care it may be kept in a liquid state considerably below that temperature. But if under these circumstances the liquid is touched with a piece of solid phosphorus, the mass instantly solidifies, and the temperature rises to the fusing point. No other substance, however, but phosphorus will, according to M. Gernez, provoke this solidification. It is the same, he says, with sulphur, naphthaline, sulphuric acid, and some other substances.

M. de Luna presented the Academy with some "*Specimens of Estremadura Phosphate,*" and also crystals of apatite from Jumilla, which he states contain 1·75 per cent. of cerium, lanthanum, and didymium. The mines at Jumilla, we are told, are worked by an English company. The author makes a suggestion that the sulphurous acid now lost at the quicksilver mines of Almaden might be employed in the production of superphosphate, and

he expects to connect Estremadura and Almaden soon by a railway. Among the specimens presented to the Academy was one, being, to all appearance, the fossil head of a femur.

A letter from M. H. Baubigny to M. H. St. Claire Deville gave an account of "*Some Derivatives of Camphor*," or *compound camphors*, as the writer terms them. The first step in the production of these compounds is the action of sodium on camphor dissolved in benzene or toluene. The mixture being carefully heated to 90°, a copious evolution of hydrogen takes place, and the sodium disappears. The liquid on cooling gives crystals which decompose in water or moist air, reproducing camphor. They are very difficult to purify, and have not been analysed, but the author supposes them to be $C_{10}H_{15}(Na)O$, or camphor in which Na is substituted for H. By means of this body the author obtains *ethylide of camphor*, or *ethylated camphor*. Iodide of ethyl being heated with the crystals, iodide of sodium separates, and the body $C_{10}H_{15}(C_2H_5)O$ is left. In like manner a *methylated camphor* may be formed, and also another series with oxygenated radicals, as acetyl and benzoyl. These matters will probably require a further investigation, and in a future number we shall give the author's ideas and processes at length.

NOTICES OF BOOKS.

Alkali Act, 1863.—Second Annual Report of the Inspector of his Proceedings during the year 1865. Presented to both Houses of Parliament. 1866.

Much as Government interference with manufacturing industry is to be deprecated upon principle, it cannot, we think, be denied that the Alkali Act has worked well both for manufacturers and the public. It is satisfactory to find that no prosecution has yet taken place under the Act, although it would appear that the escape of vapour has occasionally, at some works, exceeded that allowed by the Act. In all these cases, however, the necessary improvements have been made on the representations of the Inspectors, and thus the necessity of going to law was avoided.

On a former occasion we expressed an opinion that the Act would prove a protection to manufacturers. This Report furnishes a proof that it is so. An action is brought against a manufacturer, and the Report of the Inspector is his defence. "A strange result therefore takes place," says Dr. Smith—"we become defenders of the alkali works." To us this result is not at all strange. It is exactly what we expected; and it is clear that if manufacturers do their best and inspectors are vigilant, there is an end to actions for damages done by the escape of acid. We are therefore greatly astonished to learn that the manufacturers intend to oppose the extension of the Act. It was passed, as our readers will remember, for four years only, and the current year may be considered the last of its operation. Before it expires we hope the manufacturers will more fully consider the matter, and eventually join with us in asking for a permanent instead of a temporary Alkali Act.

Some of our readers will probably feel interested in the account of the magnitude and importance of our soda trade, which can be gathered from this Report. It is with something akin to wonder that we read that over 1000 tons of salt are converted on every working day throughout the year.

In this process, "speaking roughly," over 500 tons of dry hydrochloric acid are evolved daily, and 1 per cent., or 5 tons, escape into the atmosphere. When we calculate this escape for all the salt converted in a year, the amount becomes alarming. Some 315,000 tons of salt are decomposed in the year, and (still "speaking roughly") we may say that half this amount, or 157,500 tons, of dry acid are evolved. One per cent. of this will give 1575 tons, which represents an annual deluge of 4795 tons of commercial hydrochloric acid. Happily this enormous amount is diffused over a very wide area, and falls in a very dilute state; but still the effects of it are perceptible, and should stimulate manufacturers to perfect condensation if possible.

Before leaving the Report we may mention, for the information of those who have not seen it, that Dr. Smith gives the plan of an arrangement by which the escape of vapour when drawing a charge of sulphate of soda is prevented. How far this can be adopted in old works is a practical question we cannot enter upon; but it certainly seems to deserve the consideration of manufacturers.

Journal für praktische Chemie. No. 9. 1866.

This journal contains three contributions to agricultural chemistry by Professor A. Müller, of Stockholm. The first is a paper "*On the Chemical Analysis of Soils*," which gives a simple scheme for the separation of the mineral ingredients. The next is "*On the Amount of Nitrogen in Soils*," and gives the proportion in certain soils in Sweden. Then we have a paper "*On the Determination of Quartz in Silicates.*" The author's process for this is not likely to be generally adopted in commercial laboratories. He heats the silicate with phosphoric hydrate until the acid fumes, which, it appears, will decompose any silicate, leaving the silica in a state in which it is easily dissolved by caustic soda, or dried and weighed as usual.

The next paper is by Dr. R. Wagner, "*On the Hydrometallurgical Extraction of Quicksilver.*" The author recommends the treatment of poor cinnabars with a hot solution of sulphide of barium, which dissolves the sulphide of mercury. The subsequent addition of hydrochloric acid precipitates the black sulphide of mercury, to be reduced or used as desired. Dr. Wagner also states that cinnabar digested for a day in an excess of a solution of iodine in iodide of potassium is completely decomposed in accordance with the equation, $HgS + KI,I = HgI,KI + S$. This process may be applied to the valuation of the ore. The difference in the amount of free iodine determined by means of hyposulphite of soda will show the amount combined with mercury, and of course the quantity of mercury.

We have next a paper "*On the Occurrence of Indium in the Flue-dust of some Zinc Ovens.*" The author gives a process by which indium may be separated from a mixture of copper, iron, zinc, cadmium, arsenic, thallium, and other usual constituents of flue-dust. Indium is, perhaps, more widely distributed than has been supposed, and the paper suggests the examination of the produce of other manufactories for this rare metal.

Dr. Boettger's next paper, "*A New Process for giving Brilliant Coatings of Colour to Zinc by Chemical Means*"—which consist in merely dipping the zinc for a longer or shorter time into a warm cupro-sodic solution. Very beautiful colours can be produced in this way, as we found ourselves some time ago in making experiments with Weil's process for covering metals. We shall give the full directions on a future occasion.

The next paper by Dr. Boettger describes "*A Process for Etching in Relief on Zinc.*" It is a slight modification of the process described in the Chemical News, vol. xii., page 24. Instead of removing the zinc, as there directed, by means of nitric acid, the author immerses the plate in a strong solution of sulphate of zinc, connects it with the positive pole of a strongish battery, using as the negative electrode a thin plate of copper of equal size. The action is allowed to proceed until the etching is as high as desired. It is pointed out that the zinc employed must be free from lead.

The remaining papers consist of abstracts from other journals which we have previously noticed. We subjoin the titles of the most important:—"*On the Behaviour of*

Sulphurous Acid to Hydrated Oxide of Iridium." "*On the Alcoholate and Phosphate of Thallium,*" by M. Lamy. "*On the Quantitative Estimation of Sulphur, Phosphorus, and the Halogens in Organic Substances,*" an abstract of a memoir by Carius. The remainder consists of abstracts of papers by Berthelot, all of which have been noticed, and most published at length, in our columns, and notices of papers by Oppenheim, "*On Allylene Compounds*;" Friedel and Crafts, "*On Silicium Alcohols*;" and Ghirzer and Fittig, "*On the Derivatives of Toluol.*"

NOTICES OF PATENTS.

The first we may notice this week is one the validity of which, we believe, is still in dispute, and, therefore, we only subjoin the complete specification.

The patent was granted to Frederick Tollhausen, and was sealed, after some proceedings, by order of the Lord Chancellor, on March 27, 1866, but dates from the filing of the petition on September 7, 1865. The specification is as follows:—

"This firework is composed of a substance which, on being burnt, developes itself into a snake-like or dendrical tortuous form, producing an extraordinary effect. The matter I use for this purpose is the sulpho-cyanide of mercury, which I obtain by ordinary and known means. This matter being prepared and well dried, I form or mould it into cones or any other convenient shape, which by preference I cover with tin foil or any other matter answering the same purpose. In some cases I shall manufacture these objects in various shapes and without enveloping them in an external covering. When these objects are ready for use, light by the ignition of a match or any other description of flame being applied to the summit of the cones or to any other point that shall be indicated in any of the various forms, will cause the immediate development of the imitation serpents or other similar forms."

Pharaoh's serpents have had their day, and now, probably, Aaron's, in the shape of lawyers, will swallow all the profits of their manufacture.

There appears to be a rage for patenting the use of a solution of caustic soda. In addition to the one mentioned by our correspondent, Dr. Lunge, a week or two ago, we find another provisional specification, filed by Mr. A. Brooman, dated October 13, 1865. It is for a liquid to be used for preventing incrustations in boilers, and also for improving water when used for washing, scouring, and cleaning. It is to be made by taking 2 lbs. of soda crystals, 9 oz. of slaked lime, and 8 lbs. of water. These are to be placed in a pan and boiled for an hour, and after cooling, the clear liquor is to be drawn off for use. The ingenious inventor did not fortunately complete his patent.

Mr. Albert Julius Mott patents (No. 2660) "*Certain Improvements in the Production and Uses of Carbonic Acid Gas.*" The gas is to be evolved from alum in the form of crystals and the solution of an alkaline carbonate, and it is hardly necessary to say that to produce the gas advantageously from these materials a special apparatus is required.

Mr. Henry Ellis, of Bangor, patents (No. 2267, Sept. 2, 1865) "*Improvements in the Production of Compounds of Silica and Silicated Inks and Dyes.*" The directions for the preparation of the inks are as follows:—

"For the manufacture of 'stock ink' I use a solution of soda silicate of iron, formed by adding a solution of sulphate of iron to a concentrated solution of silicate of soda of about specific gravity 1·3, until the whole of the precipitate is thrown down. This precipitate I wash with water, and after pressing I add it in the moist state to as much solution of commercial silicate of soda of specific gravity 1·5 or thereabouts, as will dissolve the whole. I then take one part of the said solution and two parts of the archill of commerce, and after mixing them together I add as much solution of silicate of soda of specific gravity 1·3 to 1·5 as will dissolve the whole of the precipitate. This I call 'stock ink,' the colour and consistency of which may be varied in the manner already described, and which may also be converted into a copying ink by the addition thereto of a solution of silicate of soda of specific gravity 1·5 in various quantities, and by preference a solution containing an excess of alkali.

"Thus copying inks may be produced that will give a copy immediately after writing, or within a few hours, or even days, and either with or without a copying press. The inks containing an excess of silica will dry quickly, and will soonest become unfit for taking a copy after being written with; whilst those silicates containing an excess of alkali in solutions of high specific gravity, say, 1·5, will remain fit for copying for some days after they are written with.

"I do not confine myself to any strict limits in the quantities of colouring matters to be added to the soluble silicates, and, as before described, I use other compound silicates besides that of iron for the production of 'stock ink,' and soluble potash silicates may be used instead of the soda silicates.

"An useful compound for varying the consistence of the 'stock ink' will be equal quantities of archill and a solution of hydrate of soda or of potash containing 15 parts of either caustic alkali in 100 parts of water. This may be added to the 'stock ink' at discretion to suit various purposes of writing fluids.

"Various forms of carbon may also be used to vary the tint of the archill ink, and also aniline black may be so employed, either of them being added at discretion. The latter colour may be produced by the addition of a solution of magenta to a liquid paste of aniline green, or the various aniline blacks of commerce may be used for the same purpose.

"For red ink and for silicated aniline colours, magenta or other aniline colours may be used in the dry state or in the state of solution; but as dry aniline colours will not directly combine with the soluble silicates, it is necessary to use intermediate bodies, such as resins or gum resins, to effect a combination. Gamboge is well adapted for this purpose, for at the same time that it makes the magenta soluble in a solution of alkaline silicate, it also modifies the colour so as to produce a red silicated ink. Other gums, resins, or gum resins possessing analogous properties may be used in the same way with magenta and other dry aniline colours, and thus a large variety of silicated aniline colours may be produced. In some cases a solution of cochineal and other colouring matters in ammonia or other alkaline solutions may be advantageously used to vary the tint of the original ink or dye.

"The liquid aniline dyes I treat as follows:—For red ink I take aurcine one measure, and add it to an equal measure of commercial silicate of soda in solution of specific gravity 1.5. After stirring or agitating the mixture I let it stand, and then pour out the liquid part for use, leaving the sediment. By varying the quantity of either the silicate or the dye various shades of red may be produced, and gamboge or other gums, resins, or gum resins may be added at discretion, as with the dry aniline colours. Various other liquid aniline dyes may be treated in the same manner, thereby producing a great variety of solutions suitable for writing fluids of great permanency, and which will produce no corrosive action on steel or other metallic pens, and which fluids may also serve for other purposes already named.

"Documents written with inks prepared as herein mentioned may be rendered still less delible by means of a coating of a solution of supersilicate or compound silicate of potash or of soda, and paperhangings coloured with any of the dyes made in accordance with this invention may in the same manner be rendered washable without the

colours becoming altered. The silicated dyes obtained by means of the before-mentioned processes may be used either singly or in combination with each other, or with other dyeing substances, and the desiccated colours may be powdered and mixed with such of the mineral, artificial, and other colouring matters as will not be affected by the solutions of alkaline silicates, and used for colouring paperhangings or other purposes."

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

1881. W. Tongue, Wakefield, Yorkshire, "Improved methods and apparatus for steeping, boiling, bleaching, and dyeing fibrous materials."

1885. R. Irvine, Magdalen Bridge, Midlothian, N.B., and P. Brash, Leith, N.B., "Improvements in the treatment of certain residues in order to obtain fatty acids therefrom."—Petitions recorded July 19, 1866.

1905. J. Leach, Franklin Place, Hatcham, Surrey, "Improvements in refining paraffin wax."

1915. G. Mountford, Grasscroft, near Greenfield, Yorkshire, and G. L. Loversidge, Hayes Street, Manchester, "Improvements in the tanning of hides and skins."—July 23, 1866.

1933. J. Livesey, Park Street, Westminster, "Improvements in refining cast-iron."—A communication from T. Blair, Pittsburg, Penn., U.S.A.

1937. W. E. Newton, Chancery Lane, "Improvements in dyeing and hardening dyed woods, and also in preparing wood to be used in the manufacture of the cylinders of carding engines."—A communication from B. H. Jenks, Bridesburgh, Penn., U.S.A.—July 25, 1866.

Invention Protected by the Deposit of a Complete Specification.

1971. G. T. Bousfield, Loughborough Park, Brixton, Surrey, "Improvements in the manufacture of fuel from peat and such like vegetable matter."—A communication from L. Elsberg, New York, U.S.A.—Petition recorded July 31, 1866.

Notices to Proceed.

863. C. E. Amos, Southwark, Surrey, and W. Anderson, Erith, Kent, "An improved mode of treating waste liquors for the dissipating or utilising of the same.—Petition recorded March 23, 1866.

1403. J. Thomas, Battersea, and A. Prince, Trafalgar Square, Middlesex, "Improvements in the means of treating scoria or slag of copper ores, iron pyrites, or scoria from other ores containing iron, and of reducing titanic iron ore for the purpose of extracting the iron therefrom."—May 17, 1866.

1720. B. F. Weatherdon, Chancery Lane, "Improvements in apparatus for preventing incrustation in steam boilers."—A communication from J. Toth, Kecskernés, Pesth, Hungary, Austria.—June 27, 1866.

1442. J. J. Marçais, Paris, "Certain improvements in the treatment of slags, ores, and compounds of tin."—May 22, 1866.

CORRESPONDENCE.

Disinfection.

To the Editor of the Chemical News.

Sir,—The remarks contained in your number of the 20th July, on the London Cowkeepers, and their petition have just been brought to my notice, as one of the signers of that petition, I beg leave to reply to your observations.

The point of complaint of the Petition was that the Royal Commission had done wrong in referring the subject of disinfection to the patentee of a disinfectant like Dr. Angus Smith, and not that that gentleman after having been appointed the referee had recommended his own invention. the third report of the Commissioners could not possibly have been seen by the signers of the petition for the simple reason that it had not been published at the time when the petition waa written and signed. But they and the public in general had seen the previous report. which contained the very distinct recommendation of his copatentee's goods by Dr. Smith, which they quoted in their petition namely:—

"The experiments of Dr. Angus Smith show that the best disinfectants are carbolic acid (or Macdougall's powder) and chloride of lime For washing purposes Dr. Angus Smith recommends Macdougall's disinfecting soap which contains crude carbolic acid" That Dr. Smith subsequently altered his tone in the third report of the Commission was very probably due to the criticisms evoked by his previous proceedings, it was unnecessary to deny that Dr. Smith was a partner in the firm of Macdougall and Co because the petition did not say so, but merely that he was a partner with Macdougall in the patent, which has not yet been denied.

As to the character of the experiments detailed in the reports, it is but too certain that those in which carbolic acid was used were practical experiments on a large scale, but is beyond contradiction that those in which other substances were employed were laboratory experiments and nothing more. The circumstance that Carbolic Acid was allowed the advantage of large trials whereas other disinfecting agents were confined to laboratory experiments only bring out more distinctly the one-sided character of the pretended investigation.

I am, &c., Thos. Cross.

[Our correspondent is mistaken in supposing that no other substance but carbolic acid was submitted to extended trials. The last Report of the Commissioners is decisive on this point; and whether it was wrong or not (we believe it was not) to refer the matter to Dr. Smith, of one thing we feel certain—viz., that carbolic acid is the best disinfecting agent to use in cattle plague. We do not deny the value of others, but simply assert our conviction that carbolic acid is the best. The reasons we share in common with Dr. Smith are stated at length in our Report, and the facts on which they are founded are incontrovertible.—Ed. C. N.]

Action of Water on Glass.

To the Editor of the Chemical News.

Sir,—The lecture by Dr. Percy on Silicates, which appeared in the Chemical News of July 27, reminds me of one or two facts which have come under my own observation, and which may possibly prove interesting to your readers.

With regard to the action of water on glass, I may mention that for about eighteen months I had a washing bottle which was in constant use with hot distilled water, when, having broken the flask, I intended to adapt the tubes, which were quite unchanged in appearance, to another purpose; but on applying heat to the longer one it became quite white and opaque, was traversed by innumerable fissures, and, in fact, became completely devitrified. The change extended exactly as far as the cork, the portion above being quite unaltered. It was impossible to preserve the specimen, as it soon fell almost to powder.

Any one who has been accustomed to burn "shoddy" and similar substances with soda-lime for the estimation of the nitrogen will probably have noticed the fine blue colour of the tube after the ignition; and it is worthy of notice that we have in such cases all the conditions necessary for the formation of ultramarine, to which I believe the blue colour to be due. I am, &c.

Alfred H. Allen.

1, Surrey Street, Sheffield, August 4.

Chloropal in Cornwall.

To the Editor of the Chemical News.

Sir,—Some of your readers may be interested to know that chloropal occurs abundantly in a granite quarry close to the old tin mine known as Carelase. This mine, now worked mainly for china-stone and china-clay, is not far from St. Austell, in Cornwall. The chloropal occurs with fluor in the fissures of the granite, and resembles that variety of chloropal which has been termed "gramenite," from Menzenberg, near Bonn. I am, &c.

A. H. Church.

Starch.

To the Editor of the Chemical News.

Sir,—In your report of Dr. Percy's sixth lecture the following statement occurs:—"Smalts is still used to colour starch. Starchmakers have tried to substitute the artificial ultramarine, but in vain." This is altogether incorrect; smalts are quite superseded by ultramarine, which is now generally, I believe universally, used for the purpose. Any one may prove this for himself by treating the starch of commerce with a little dilute acid, which will quickly discharge the colour. I am, &c.

C. H. B.

London, N.E., August 7.

MISCELLANEOUS.

The Purification of Water.—Dr. Frankland has made the following communication to the Registrar-General:—

"Royal College of Chemistry, August 4, 1866.

"Sir,—In compliance with your request I have made a special analysis of the water supplied by the East London Company, and collected on the 1st instant. The following are the results, together with those yielded by the water supplied by the same company on July 1, and on the average of a whole year:—

	Solid matter in 100,000 parts.	Organic and other volatile matter in 100,000 parts.	Oxygen required to oxidise the organic matter.	Degree of hardness.
				Deg.
East London Company's water, collected August 1, 1866 . .	26·14	1·44	·0328	17·7
East London Company's water, collected July 1, 1866 . .	24·38	1·94	·0344	16·6
East London Company's water (average of one year) . . .	27·98	1·62	·0504	21·12

"It is the amount of organic matter contained in this water which is of especial importance in connexion with the outbreak of cholera in the district supplied by this company. The above results that, in this respect, the water supplied on August 1, is considerably better than that supplied on July 1, when the amount of this ingredient was markedly above the average. Chemical analysis, therefore, although it shows a larger quantity of organic matter than ought to be contained in water used for drinking purposes, does not reveal any exceptional degree of pollution in this water. It must be borne in mind, however, that chemical investigation is utterly unable to detect the presence of choleraic poison amongst the organic impurities of water, and there can be no doubt that this poison may be present in quantity fatal to the consumer, though far too minute to be detected by the most delicate chemical research.

"It is thus that the occurrence of cases of cholera, or of choleraic diarrhœa, upon the banks of any of the streams, from which the water supply of London is so largely derived, may at any moment diffuse this poison over large areas of the metropolis. For the prevention of such a catastrophe there is a method which deserves considerable confidence. In my last three monthly reports to you on the metropolitan waters I have shown that filtration through animal charcoal (boneblack) removes practically the whole of the organic matter from the New River water; and in numerous other experiments I have ascertained that this process is equally efficient even when applied to the foul waters of ponds and ditches. I have also proved that its action continues unimpaired for three months, and will probably last for a year, even when very large volumes of water are passed through it. Animal charcoal alone has this power, vegetable charcoal being perfectly inert.

"I would, therefore, most earnestly recommend that during the prevalence of cholera the whole of the water supplied to the metropolis should be passed through animal charcoal immediately before transmission to consumers from the reservoirs of the respective companies. For this purpose 300 tons of bone-black, in the condition in which it is used by sugar refiners, would be required to purify the total supply of the metropolis, as I find that water passed at the rate of 1,000,000 gallons in twenty-four hours through three tons of bone-black, is completely purified. This operation, even when performed upon the water supply of London (100,000,000 gallons daily), would be neither formidable nor expensive. Three or four days would suffice to fix the necessary filtering boxes, whilst the animal charcoal, being an article which is now manufactured on a very large scale, can be had on the shortest notice. It is scarcely necessary to add that the water should be passed through the animal charcoal after it has undergone the usual process of filtration.—I have, &c.,

"E. Frankland."

In another letter addressed to the Secretary of the East London Water Works Company, Dr. Frankland has recommended the immediate use of permanganate of potash to be applied after filtration, and immediately before the water is transmitted to the consumer.

British Pharmaceutical Conference.—We may call attention to the admirable arrangements made at Nottingham for the members of the Pharmaceutical Conference. A large private hotel has been engaged for the sole use of the members. In a town affording but limited accommodation like Nottingham, this will be thoroughly appreciated, especially when we add that we have been asked for private apartments in the town rather more than six times the amount we paid for the same accommodation at Birmingham last year.

Royal Polytechnic Institution.—The annual meeting was held on Saturday last, and a very favourable report and balance-sheet were presented. The attractions of the entertainment would appear to increase, and the directors were able to declare a dividend at the rate of 6 per cent. per annum. Professor Pepper was present, and we are happy to receive the announcement that his recovery from a long and very severe illness is now nearly complete. In view of the coming winter season, we may ask again, would it not be possible to give a more definitely instructive character to the lectures?

Working of the Atlantic Telegraph.—The following information will no doubt be of interest to all our readers. It is supplied by Mr. Philip Crookes in a letter to the Editor, dated Valentia, August 1:—"On Thursday we took the instruments to Foilhummerum, and on Friday got a preliminary test sufficient to say that all was right and they might go on working. On Saturday we commenced testing regularly (stopping now and then to enable them to forward messages), and on Sunday we finished the tests. It was tested at each end, Mr. Lawa being at one (the Newfoundland) end, and Mr. Clark and I at the other. It has improved in insulation about six times since it was laid, owing to the lower temperature and the pressure; altogether it is perfect. You ask me about the messages: at present they are read on a Thompson's reflecting galvanometer, worked with ten Daniell's cells,

and so arranged as to limit the deflections to about a quarter of an inch on each side, the right hand being *dashes*, the left *dots*. They work about six words per minute (or at about the rate you and I can send when our instruments are in order). but it requires great experience to send well on such a long submarine line, and a great deal depends on the signallers. With two of their best men yesterday they sent eighty-three words in eleven minutes without a single repetition or misunderstanding, while at other times they may not get more than five per minute. During the tests we could communicate at once with Mr. Laws and give and receive directions as required. I will give a few extracts:—Valentia to Newfoundland: 'Will now take tests in order as arranged: send length of cable laid.' Newfoundland: 'Length of cable laid= 1852·115 knots.' Valentia: 'Look out for time signal at 9·12.' Directions as to tests follow. Newfoundland: 'Put end to earth till 12·10, and then insulate till 12·35.' Valentia: 'That is only 25 minutes' insulation.' Newfoundland: 'Yes.' Valentia: 'Good.' And so on, which shows the ease with which people can converse at a distance of nearly 2000 miles from each other."

Sodium Amalgam in the Colorado Gold Mines.—An extract from the *Colorado Journal*, quoted in the *American Journal of Mining*, for July 14, informs us that by the use of sodium amalgam the yield of the Narragansett mill has been increased more than 30 per cent. The same journal for July 21 quotes as follows:—"Mr. John P. Bruce is running his old twelve stamp mill, two batteries, six stamps in each. For four days last week he used the mercury treated by sodium amalgam in one battery, and common mercury in the other. He got one ounce and nineteen dwts. more gold in the former than in the latter. Mr. Emery also tried some of it in the Narragansett mill just before it shut down. In one section of twenty heavy stamps he used the sodium amalgam for two batteries, and the common mercury for the other two during a run of three days, obtaining from the former five ounces of amalgam more than from the latter, which retorted $6·50 an ounce, or $32·30 in all. At the same rate the use of it in the forty stamps of the Narragansett mill for a week would increase the yield by $260. Probably this result would be even better with more experience."

Coal Oil in S. Paulo.—To-day Captain R. Burton, H.B.M. Consul at Santos, appeared at our office, and showed us the results of his late valuable discovery. We congratulate the concessionists of the S. Paulo and Parahyba Valley Railroad; this "find" will have an excellent effect upon the market. The first step would be to send up a sound working engineer, not one of the theoretical gentlemen in whom Brazil is unfortunately so rich, but a man who has practically learned the art and mystery of "striking ile." The traveller who has lately been studying the analogies of the African and South American continents was struck by the fact that the great coal field which Dr. Livingstone visited in his first exploration to the valley of the Zambezi was on the second exploration discovered near the Rufuma River, and afterwards Mr. Morewood, now resident at Taubaté, found it extending over the north of Natal. Captain Burton had seen specimens from the province of Rio Grande and had heard of the fields of Santa Catharina. Looking, therefore, at the basins of the Parahyba River and the Ribeira do Iguape, he was persuaded by their geological formation that the deposit would run northward to the province of S. Paulo; and he has succeeded in establishing the fact. When riding across the country from S. Paulo to Rio, Captain Burton was accompanied by a party of friends, Senor Moreira de Barros, the local deputy, Lieut.-Col. José Francisco Monteiro, and others, to the village-town of Bom Jesus de Tremembé. Here, on the southern bank of the Parahyba, he was shown a so-called "pissarra" (hard clay) in which he at once recognised the bituminous shale which overlies the true coal measures, and in which petroleum almost necessarily exists. After ascertaining that this shale bed extends along the Parahyba River for many leagues, Captain Burton proceeded to seek for the sandstones which characterise the deposits of Rio Grande. On the next day he succeeded. Lieut.-Col. Monteiro guided him to the rolling ground south of the river, and showed him at the distance of a league (=4 miles) a red hill upon which appeared rocks of sandstone, many of them heavy with hæmatite. This was decisive. Another league to the south a fine deposit of lime was found, varying in quality from the rough material for burning to a fair saccharine marble. Lieut.-Col. Francisco Antonio Monteiro, of Taubaté, asked the traveller to secure the services of some working engineer who can build for him kilns of the very latest and most economical plan, and capable of burning at a time from 8000 to 10,000 bushels. Captain Burton has requested us to give publicity to this desideratum. The Lieut.-Colonel is a wealthy landed proprietor who will liberally reward success. Captain Burton placed upon our table the three little parcels which will show the way to many a fortune. Here are limestone, ironstone, and coal, all lying within the space of 8 miles. The position, about halfway between S. Paulo and the Barra do Pirahy, is upon the line that must be taken by the Pedro Segundo Railroad in case it runs west, or by the new branch of the Santos and S. Paulo which proposes to run east. The country offers no obstruction whatever to a light line of rails upon the American backwoodsman principle, and the expense might easily be reduced to half of what is usually lavished upon Brazilian railways. The first step, we have said, would be to send up some practical man for the purpose of ascertaining the presence of oil. Boring tools are to be found at Rio, even for making artesian wells, one of which was lately attempted upon the Morro do Castello. We strongly urge this measure upon the Government, and more especially upon those of the Ministry who are patriotically interested in the province of S. Paulo. His Excellency Senor Paula Souza cannot better serve his native land. When oil is struck, then coal excavations may be made.—*The Anglo-Brazilian Times, July 2.*

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. XIII. of the Chemical News, containing a copious Index, is now ready, price 11s. 6d., by post, 11s. 6d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I., II., and VII. are out of print. All the others are kept in stock. Vol. XIV. commenced on July 7, and will be complete in 26 numbers.

T. R. P. will find his question answered at length in the paper by M. Kopp.

T. C.—After the chlorine liquor, boil with a small quantity of the stone, and the iron should be precipitated.

R. M.—Carbonate of zinc is obtained by precipitating sulphate of zinc with carbonate of soda, but is always combined with hydrated oxide. The mixture would answer your purpose. The precipitated blue and precipitated zinc should be mixed in the moist state, and then moulded and dried. Soda crystals are obtained by simply boiling down the solution to the proper point and cooling it. You have probably dried yours too much.

F. S. J.—The proportion will be found in the patent. The properties of the sulphites are briefly described in most books on chemistry. Nothing definite is known of the salts of carbolic acid. There are no reliable reagents for its detection.

L. T.—We believe the first announcement was made by Professor Stokes in 1853, and his several papers on the subject will be found in the *Proceedings of the Royal Society* for that and subsequent years. The best form of apparatus for exhibiting the fluorescence is a vessel of the solution, in which is placed a Geissler's tube illuminated by a Ruhmkorff coil. We have not seen Mr. Scott's artificial quinine.

Received.—Mr. W. N. Hartley's Notes shall be published next week.

Books Received.—On Epidemic Diarrhœa and Cholera; their Nature and Treatment. By Geo. Johnson, M.D. Lond.

CARBOLIC ACID.

F. C. CALVERT and CO., of 7, Bond Street, Manchester (original Manufacturers of Medical Carbolic Acid), beg to inform the Trade and large consumers that their Pure Medical Carbolic, as well as cheaper qualities for Commercial, Veterinary, and Disinfecting purposes, may be had from any of the undermentioned London Agents:—

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BRITISH ASSOCIATION for the ADVANCEMENT of SCIENCE.—NOTTINGHAM MEETING, 22nd AUGUST, 1866.

President—W. R. GROVE, Esq., M.A., Q.C., F.R.S., &c.

GENERAL ARRANGEMENTS.

Wednesday, 22nd August—President's Address, at 8 p.m., in the Theatre.

Sectional Meetings as usual, from the 23rd to the 28th, inclusive.

Thursday, 23rd August—Soirée in Exhibition Building.

Friday, 24th August—Lecture at 8.30 p.m., in the Theatre, by W. Huggins, Esq., F.R.S., F.R.A.S., On the Results of Spectrum Analysis applied to the Heavenly Bodies.

Monday, 27th August—Lecture by J. D. Hooker, Esq., M.D., D.C.L., F.R.S., &c., On Insular Floras.

Tuesday, 28th August—Soirée in the Exhibition Building.

Saturday, 25th August—Excursions to the Midland Railway Works at Derby, Eastwood, Riddings, Cinder Hill, Annesley, and Newstead Abbey.

Thursday, 30th August—Excursions to the Derwent and Wye Valleys, Charnwood Forest, and Belvoir Castle.

On and after July 30th, until August 17th, Life Members, who intend to be present at the Meeting, may receive their Tickets by applying to the General Treasurer, and returning to them their Life Member Invitation Circular; Annual Subscribers, who wish to receive their Tickets, must return their Invitation Circular, with £1 enclosed, to the General Treasurer, W. Spottiswoode, Esq., 50, Grosvenor-place, London, S.W.

The Executive Committee at Nottingham will elect New Members and Associates on the following conditions:—

New Life Members, for a composition of £10, which entitles them to receive gratuitously the Reports of the Association which may be published after the date of payment.

New Annual Subscribers, for a payment of £2 for the first year. These receive gratuitously the Reports for the year of their admission, and for every following year in which they continue to pay a subscription of £1 without intermission.

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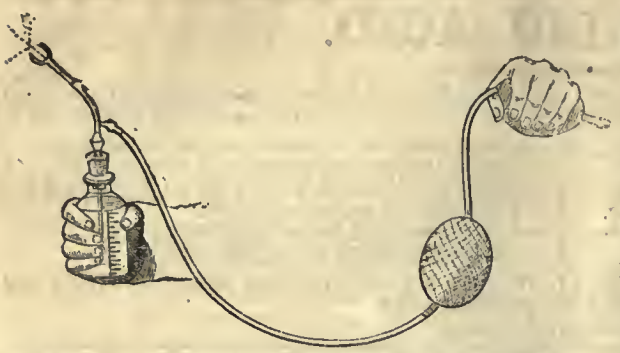

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THE

CHEMICAL NEWS

AND

Journal of Physical Science.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

A Few Notes on Magnesium, by Walter Noel Hartley.

Before the publication of M. Roussin's paper (Chem. News, p. 27) I had made the experiments which form the substance of the following notes. My results, with one exception, confirm his statements.

Magnesium decomposes perfectly pure cold water slowly, but evolves hydrogen more briskly from saline solutions, especially if a little chloride of platinum be added. The disengagement of gas is very active in a dilute solution of this salt, probably on account of electrolytic action between the precipitated platinum and the magnesium. Similar cases are well known—*e.g.*, the addition of sulphate of copper to the contents of a Marsh apparatus, and chloride of platinum to tin and hydrochloric acid when hydrogen is made by this method. No hydrogen is evolved from solutions of phosphate of ammonia, the nitrates and sulphides of the alkalies and alkaline earths, permanganate of potash, and peroxide of hydrogen; the two latter probably exert an oxidising influence on the metal. To the nitrates the ammonia salt is an exception, the evolution of gas being as brisk as from other salts. It has been stated (Miller's "Chemistry," vol. ii.) that magnesium takes fire when thrown on to strong hydrochloric acid; but with the strongest possible acid, either hot or cold, I found nothing take place beyond a very violent disengagement of hydrogen.

Most metals are precipitated by magnesium from their solutions, but I could not succeed in precipitating iron; the magnesium becomes blackened, probably from a deposition of metallic iron, but the deposit disappears again as the magnesium is dissolved. I did not get satisfactory results with cobalt. I was induced to try the precipitation of iron by the thought that it would lead to a good method of separating phosphoric acid from iron and alumina. The plan proposed was to add some magnesium to the acidulated solution, filter off the precipitated iron, add tartaric acid, chloride of ammonium, and ammonia, and filter, the precipitate being phosphate of magnesia and ammonia. Magnesium is to be preferred to zinc in some analytical operations—for instance, for the precipitation of copper in a platinum vessel, the most accurate way of estimating it; also in the reduction of per- to prot-oxide of iron, the metal being always pure, and requiring so little acid for its complete solution.

Magnesium may be amalgamated like zinc by shaking in a bottle containing mercury covered with a layer of dilute sulphuric acid; when so treated it possesses the property of the amalgam described by Messrs. Wanklyn and Chapman—viz., of decomposing water violently. I made use of this amalgamated magnesium instead of sodium amalgam, to act on an organic substance with nascent hydrogen, as the liquid was not so intensely alkaline as it would otherwise have been. In testing for nitric acid by boiling cadmium with the solution, and after addition of acid testing with iodide of potassium and starch-paste, magnesium may be used with advantage; but a modification of this method is really the best test for traces of nitrates—for instance, in drinking waters. If a small battery be made of a piece of magnesium ribbon and platinum foil, and this be placed in the water very faintly acidulated, without the joining of the platinum and magnesium being immersed, the presence of nitric acid may be shown by its conversion into nitrous acid and the consequent coloration of ozone papers when dipped in the acidified liquid. Should the trace of nitric acid be very small, the action must go on slowly for several hours, in which case the liquid should be neutral when acting on the magnesium. I found sulphate of iron and sulphuric acid did not give trustworthy results when a solution contained $\frac{1}{10000}$th of a nitric salt, while distinct indications were obtained on ozone papers in the way above mentioned in presence of 35,000 parts of water.

A convenient way of testing is to wrap an ozone paper round a platinum spatula, and wrap over this magnesium tape and connect at the top with the spatula; where the magnesium touches, the paper remains white; where exposed, it becomes tinged purple. I wished to try the value of this test by many more experiments than those already made, and to find the cause of there being no evolution of gas from alkaline nitrates in contact with magnesium (it is probably from a process of reduction to nitrites going on), but I now judge it best to make known the few facts here stated, as at present I have not an opportunity of continuing my experiments.

Note.—I may state that boiling magnesium in a solution containing a trace of a nitrate is not so delicate a test as the sulphate of iron one.

An Introduction to Chemical Philosophy, according to the Modern Theories, by Adolphe Wurtz, *F.R.S.*

Part III.

Connexion between Organic and Inorganic Chemistry.

Section III.—*Combinations of Multiple Radicals.*

(*Continued from page* 63.)

Many other basic compounds of inorganic chemistry possess an analogous constitution. We will mention some from the different kinds of salts. We must first remark that these basic salts always contain a polyatomic metal; the well-defined monatomic metals—such as potassium, sodium, and even silver—not forming basic salts properly so called.

Basic Nitrates.

$$\left.\begin{matrix}Pb_3\\(N\Theta_2)_2\end{matrix}\right\}\Theta_4 \qquad \left.\begin{matrix}Hg_3\\(N\Theta_2)_2\end{matrix}\right\}\Theta_4 \qquad \left.\begin{matrix}(Hg_2)_2\\(N\Theta_2)_2\end{matrix}\right\}\Theta_3+\text{aq.} \qquad \left.\begin{matrix}Pb_2\\N\Theta\\N\Theta_2\end{matrix}\right\}\Theta_3$$

Triplumbic dinitrate. (Berzelius.) — Trimercuric dinitrate. (Kane.) — Dimercurous dinitrate; yellow crystalline salt. (Kane).* — Nitrosonitrate of lead. Basic hyponitrate of lead of M. Peligot.

Basic Sulphates.

$$\left.\begin{matrix}Cu_4\\S\Theta_2\end{matrix}\right\}\Theta_5+4\text{ aq.} \qquad \left.\begin{matrix}Hg_3\\S\Theta_2\end{matrix}\right\}\Theta_4.$$

Brochantite. — Turbith mineral.

Basic Carbonates.

Carbon being a tetratomic element, like silicium, the composition of the normal carbonic hydrate should be—

$$\left.\begin{matrix}C\text{iv.}\\H_4\end{matrix}\right\}\Theta_4,$$

and the normal carbonates should contain—

$$\left.\begin{matrix}C\text{iv.}\\4R'\end{matrix}\right\}\Theta_4 \quad \text{or} \quad \left.\begin{matrix}C\text{iv.}\\2R''\end{matrix}\right\}\Theta_4.$$

These carbonates Dr. Odling has called *orthocarbonates*;† but we know that the most numerous and best defined carbonates belong to the type—

$$\left.\begin{matrix}C\text{iv.}\\2R\end{matrix}\right\}\Theta_3;$$

or, in other words, that in these carbonates the ratio of

* Polymere of the soluble mercurous nitrate of Gerhardt (p. 15).

† *Philosophical Magazine*, vol. xviii., p. 368.

the oxygen of the acid to that of the oxide is 2 : 1. It seems then natural to consider these latter carbonates as neutral or normal. Their constitution may be expressed by the formula—

$$\left.\begin{matrix}(\overline{C}O)''\\ 2R'\end{matrix}\right\}O_2;$$

and the orthocarbonates may be considered as basic carbonates of the formula—

$$\left.\begin{matrix}2R''\\ (\overline{C}O)''\end{matrix}\right\}O_3,$$

derived from the type

$$\left.\begin{matrix}2R''\\ H_2\end{matrix}\right\}O_3$$

That being laid down, we may admit the existence of basic carbonates belonging to several types, and in which the oxygen of the oxide Oo is to the oxygen of the acid Oc in the following ratios :—

Oe : Oc : : 2 : 2 bibasic carbonates.
Oe : Oc : : 3 : 4 sesquicarbonates.
Oe : Oc : : 3 : 2 carbonates of the sesquioxides.

Bibasic Carbonates.	*Sesquicarbonates.*	*Carbonates of the Sesquioxides.*
$\left.\begin{matrix}2\overline{C}u\\ \overline{C}O\end{matrix}\right\}O_3+aq.$‡ Malachite.	$\left.\begin{matrix}3\overline{C}u\\ 2\overline{C}O\end{matrix}\right\}O_5+aq.$ Azurite.	$\left.\begin{matrix}Fe_2^{vi.}\\ \overline{C}O\end{matrix}\right\}O_4$ Ferric carbonate. (Parkmann.)
$\left.\begin{matrix}2\overline{C}u\\ \overline{C}O\end{matrix}\right\}O_3$ Mysorine?	,, ,,	$\left.\begin{matrix}Ur_2^{vi.}\\ \overline{C}O\end{matrix}\right\}O_4$ Uranic carbonate. (Ebelmen.)
$\left.\begin{matrix}2\overline{P}b\\ \overline{C}O\end{matrix}\right\}O_3+aq.$ Subcarbonate of hydrated lead. (Bounsdorff.)	$\left.\begin{matrix}3\overline{P}b\\ 2(\overline{C}O)\end{matrix}\right\}O_5+aq.$ Dutch whitelead. (Hochstetter.)	$\left.\begin{matrix}\overline{C}r_2^{vi.}\\ \overline{C}O\end{matrix}\right\}O_4$§ Chromic carbonate. (Parkmann.)
$\left.\begin{matrix}Zn_2\\ \overline{C}O\end{matrix}\right\}O_3+2aq.$ Subcarbonate of hydrated zinc. (Schindler.)	$\left.\begin{matrix}2Bi'''\\ 2\overline{C}O\end{matrix}\right\}O_5+aq.$ Carbonate of bismuth.	

There exist basic silicates. Thus staurotide may be looked upon as a basic compound of the form—

$$\left.\begin{matrix}4\overline{Al}_2^{vi.}\\ 3Si\end{matrix}\right\}O_{13},$$

in which the sixth part of the aluminium is replaced by ferricum.

In the inorganic compounds that we have just reviewed we see polyatomic elements accumulate in one and the same combination, uniting one with another doubtless by the intervention of atoms of oxygen (page 61). We find this property in other organic and inorganic compounds, in which we see the radicals of polyatomic acids accumulated in one and the same combination. Let us investigate this point.

By the oxidation of diethylenic alcohol there is formed a compound which I have called diglycolic acid,‖ and in which the two ethylene radicals of the alcohol are replaced by two glycolyl radicals.

$$\left.\begin{matrix}2(C_2H_4)\\ H_2\end{matrix}\right\}O_3, \qquad \left.\begin{matrix}2(C_2H_2\overline{O})\\ H_2\end{matrix}\right\}O_4.$$

Diethylenic alcohol. Diglycolic acid.

M. Friedel and I have described the ethers of a dilactic and of a trilactic acid which possess a constitution analogous to that of diglycolic acid.¶

$$\left.\begin{matrix}2(C_3H_4\overline{O})\\ H_2\end{matrix}\right\}O_3, \qquad \left.\begin{matrix}3(C_3H_4\overline{O})\\ H_2\end{matrix}\right\}O_3.$$

Dilactic acid Trilactic acid.

In a very important article, M. H. Schiff** has lately made known a ditartaric acid—

$$\left.\begin{matrix}2(C_4H_4O_4)''\\ H_2\end{matrix}\right\}O_3.$$

Analogous combinations exist in inorganic chemistry. I may mention disulphuric (Nordhausen acid), dichromic, and diphosphoric acids, whose salts are represented by the following formulæ:—

$$\left.\begin{matrix}2(S\overline{O}_2)\\ K_2\end{matrix}\right\}O_3 \qquad \left.\begin{matrix}(\overline{C}rO_2)''\\ (\overline{C}rO_2)''\\ K_2\end{matrix}\right\}O_3 \qquad \left.\begin{matrix}(P\overline{O})'''\\ (P\overline{O})'''\\ Na_4\end{matrix}\right\}O_3$$

Disulphate of potassium (anhydrous). Dichromate of potassium. Pyrophosphate of sodium.††

We know that MM. Maddrell‡‡, Fleitmann, and Henneberg have described a series of acids polymeric with metaphosphoric acid, and which may be looked upon, in common with all the compounds here referred to, as anhydrides formed by the condensation of several molecules of phosphoric acid with elimination of water.

$$2\left[\left.\begin{matrix}(P\overline{O})'''\\ H_3\end{matrix}\right\}O_3\right] = \left.\begin{matrix}2(P\overline{O})'''\\ H_2\end{matrix}\right\}O_4+2H_2\overline{O}$$

Phosphoric acid. Dimetaphosphoric acid.

$$3\left[\left.\begin{matrix}(P\overline{O})'''\\ H_3\end{matrix}\right\}O_3\right] = \left.\begin{matrix}3(P\overline{O})'''\\ H_3\end{matrix}\right\}O_8+3H_2\overline{O}$$

Trimetaphosphoric acid.

$$4\left[\left.\begin{matrix}(P\overline{O})'''\\ H_3\end{matrix}\right\}O_3\right] = \left.\begin{matrix}4(P\overline{O})'''\\ H_4\end{matrix}\right\}O_8+4H_2\overline{O}, \text{ \&c.}§§$$

Tetrametaphosphoric acid.

M. Friedel and I‖‖ have made known the ether of a mixed acid formed by the union of one molecule of lactic acid with one molecule of succinic acid, with elimination of water—

$$\left.\begin{matrix}(\overline{C}_3H_4\overline{O})''\\ H_2\end{matrix}\right\}O_2+\left.\begin{matrix}(\overline{C}_4H_4O_2)''\\ H_2\end{matrix}\right\}O_2=\left.\begin{matrix}(C_3H_4\overline{O})''\\ (\overline{C}_4H_4O_2)''\\ H_2\end{matrix}\right\}O_3+H_2\overline{O}$$

Lactic acid. Succinic acid. Lacto-succinic acid.

Lacto-succinic acid, whose ether we have analysed—

$$\left.\begin{matrix}(\overline{C}_3H_4\overline{O})'\\ (\overline{C}_4H_4O_2)''\\ (C_2H_5)_2\end{matrix}\right\}O_3$$

contains both the radical of lactic acid and that of succinic acid, and these radicals are probably united one to the other by an atom of oxygen. A certain number of other organic and inorganic acids are formed in a like manner, and possess an analogous constitution. Thus M. Bolley's chromosulphuric acid contains—

$$\left.\begin{matrix}(\overline{C}rO_2)''\\ (S\overline{O}_2)''\\ H_2\end{matrix}\right\}O_3$$

‡ $Aq=H_2\overline{O}$.

§ The chromic dicarbonate analysed by M. Parkmann (*Bulletin de la Société Chimique*, vol. v., p. 551)—

$$\left.\begin{matrix}\overline{C}r_2^{vi.}\\ 2\overline{C}O\end{matrix}\right\}O_5 \quad \text{or} \quad \left.\begin{matrix}C_2\\ \overline{C}r_2\end{matrix}\right\}O_7$$

may be compared to a disilicate (p. 62). In general the carbonates may be referred to the type

$$\left.\begin{matrix}\overline{C}iv.\\ 2R'\end{matrix}\right\}O_3$$

which corresponds to the first carbonic anhydride—

$$\left.\begin{matrix}\overline{C}iv.\\ H_2\end{matrix}\right\}O_3=\left.\begin{matrix}\overline{C}iv.\\ H_4\end{matrix}\right\}O_4-H_2\overline{O}.$$

Annales de Chimie et de Physique, 3rd series, vol. lxix., p. 344.

¶ *Annales de Chimie et de Physique*, 3rd series, vol. lxiii., p. 112.

** *Ibid.*, vol. lxix., p. 257.

†† *Annalen der Chemie und Pharmacie*, vol. lxi., p. 53.

‡‡ *Ibid.*, vol. lxv., p. 304, and vol. lxxii., p. 232.

§§ We may foresee the existence of anhydrides

$$\left.\begin{matrix}3(P\overline{O})\\ H\end{matrix}\right\}O_3 \quad \text{and} \quad \left.\begin{matrix}4(P\overline{O})\\ H_2\end{matrix}\right\}O_7$$

formed according to the principle of *successive dehydrations*, as shown at page 61 and the following pages.

‖‖ *Annales de Chimie et de Physique*, 3rd series, vol. lxiii., p. 122.

M. Friedel and I have compared sphene, or silico-titanate of calcium, to the lacto-succinate of ethyle—

$$\left.\begin{matrix}(SiO)''\\(TiO)''\\Ca''\end{matrix}\right\}O_3\P\P$$

Other inorganic kinds are formed by the condensation of the elements of two acids with elimination of water. This is the case with the borosilicates. The hydrate corresponding to datholite would be formed by the combination of 2 molecules of boric acid and 2 molecules of silicic acid, with elimination of 5 molecules of water—

$$2\left[\begin{matrix}Bo'''\\H_3\end{matrix}\right\}O_3\Big]+2\left[\begin{matrix}Si^{iv.}\\H_4\end{matrix}\right\}O_4\Big]=\left.\begin{matrix}2Si^{iv.}\\2Bo''\\H_4\end{matrix}\right\}O_9+5H_2O$$

$$\left.\begin{matrix}Si_2\\Bo_2\\Ca_2\end{matrix}\right\}O_9+aq.$$

Datholite.

(To be continued.)

New Researches on the Law of Chemical Proportions and on Atomic Weights and their Mutual Relations, by J. S. STAS.*

THE following is the introduction to the new researches recently published by M. Stas. A full abstract of the researches themselves will follow in our pages:—

I have the honour to present to the Academy three memoirs, containing a detailed exposition of the labours I have undertaken on the subject of the law of chemical proportions and on atomic weights and their mutual relations. These have been prosecuted as a new control of the results first made known in 1860 in my "*Researches on the Reciprocal Relations of Atomic Weights*," and at the same time to reply to the objections raised against the conclusions with which, after mature reflection, I terminated that memoir. As far as has been possible, I have in this introduction brought together the questions of which I treated, the results I arrived at, and the consequences that flowed from them. I have done this in order to give those who are not interested in analytical details a general idea of my labours, and the train of thought that guided me.

Prout laid down the principle that the atomic weights of all simple bodies are multiples in whole numbers of that of hydrogen. I have said in my former memoir that the unifermity admitted by Prout was soon shown to be incorrect; but the law which he had propounded was still regarded by a great number of chemists as perfectly founded on fact. M. Dumas, in particular, profoundly convinced of the truth of Prout's law, believes that all atomic weights are multiples of that of hydrogen by 1·00 or by 0·50 or by 0·25. My own researches on nitrogen, chlorine, sulphur, potassium, sodium, lead, and silver, published in 1860, led me to the contrary conclusion—"that there exists no common divisor between the weights of simple bodies which unite with each other to form definite compounds." I have considered, therefore, the hypothesis of Prout as a pure illusion, and have regarded all the reputed undecomposable bodies as distinct entities, having no simple relation of weight one to another.

These conclusions, however positive they may seem, have been accepted by a great number of chemists in Germany, England, and Italy, but not in France. The reason for this difference is to be found in the profound conviction produced in the minds of most French chemists by the works of my illustrious teacher (M. Dumas) on the same subject.

However delicate may be my position in this matter, I must seek out the foundation for this conviction. To this end I propose to examine the objections brought against the conclusions of my work. I shall then examine the idea that inspired Prout when he enunciated his hypothesis, and lastly I shall bring together the different investigations I have undertaken to answer objections, to control previous researches, and some entirely new.

My memoir had scarcely appeared when M. Marignac hastened to give an analysis of it in the *Bibliothèque Universelle de Genève*, following it up with some objections against the conclusions I had deduced, which he considered too positive. I pass over the compliments of the celebrated Genevese chemist to come at once to his objections.† I shall quote them for the most part *in extenso*, that every one may understand them. "When," says M. Marignac, "I place beside the numbers of M. Stas those I formerly obtained myself, it is not with the single object of pointing out the close approximation; it seems to me that an important consequence may be drawn. On studying the great work of M. Stas, I have seen that in his experiments he has taken infinitely more minute care than I thought it necessary to take, either for the purification of the bodies submitted to experiment, or to insure the accuracy of the weighings, or in all the precautions that could be imagined to remove every cause of error. His results offer much stronger guarantees for accuracy than mine, and yet it is seen how little they differ, and it will be particularly remarked that they are on the average nearer than mine to the numbers calculated according to Prout's law.

"It seems to me that we may conclude that if, after still further improvements in the means of purification of bodies and in experimental methods, any future chemist goes through the same series of experiments with even greater guarantees of accuracy, the difference that might be manifested between his results and those of M. Stas would probably be of the same kind as those that exist between mine and M. Stas', and would show a closer agreement with the law of Prout. My opinion being thus stated, it may be wondered why I do not entirely agree with the conclusions of M. Stas, and regard Prout's law as a pure illusion. Allow me," adds M. Marignac, "to make some observations on these conclusions, which appear to me too absolute; they will bear on two distinct points:—

"First, I must avow that I shall only be convinced of the exactness of an atomic weight when that weight has been obtained by several methods absolutely independent of one another, and resting on the analysis of several compounds quite distinct."

I perfectly agree with M. Marignac on this point, as is proved by the fact that in my researches on the reciprocal relations of atomic weights I have given absolutely independent elements for the calculation of the atomic weight of silver, although, however, the principal object of my experiments was to determine the relations of the atomic weights and not the atomic weights themselves. For the rest it will be seen further on that I have endeavoured to satisfy the desire expressed by M. Marignac.

"I expressly add," continues M. Marignac, "that I

¶¶ Or,

$$\left.\begin{matrix}Si^{iv.}\\Ti^{iv.}\\Ca''\end{matrix}\right\}O_5$$

Annales de Chimie et de Physique, 3rd series, vol. lili., p. 124.

* *Memoirs of the Royal Academy of Belgium.*

† These will be found at p. 57, vol. v., of the CHEMICAL NEWS.

understand by different methods those that rest on the analysis and synthesis of absolutely distinct compounds, and not those alone which only differ in the manner the same compounds are made to react. Thus, when M. Stas quotes as a control of the synthesis of nitrate of silver the experiments by which he determined the proportional relation between this salt and chloride of potassium, I see only a proof of the accuracy of the experiments themselves, and by no means of the experimental method."

On this point I do not share the opinion of my celebrated opponent. The agreement of the results obtained by the aid of the control proves not only that the experiments were made with exactitude, but further that the synthesis of nitrate of silver, as well as the normal composition of that salt, is not reconcilable with the law of Prout. To escape, indeed, from this consequence, M. Marignac is obliged to resort to an hypothesis which is *a negation of the principle on which the determination of atomic weights rests.*

"If from any cause whatever," he says, "nitrate of silver most carefully prepared does not contain its elements in their rigorous atomic proportions, the most accurate methods applied to its analysis or synthesis will only give the relations of the atomic weights with the same inaccuracy.

"Here, in fact, is the principal cause of the doubt that reigns in my mind. It is not absolutely proved to my satisfaction that many compound bodies do not constantly and normally contain an excess (very small, no doubt, but still appreciable in very delicate experiments) of one of their elements."

The objection of M. Marignac means that it is not demonstrated that in stable chemical combinations (and I suppose that sulphide and nitrate of silver are such) the elements which constitute them are exactly and invariably in the relation of their atomic weights. It seems to me that this opinion, if it is founded on fact, tends to upset all our fundamental notions; the law of definite proportions, the law of multiple proportions cease to be mathematical laws; they necessarily become only limited laws. The hypothesis of the existence of atoms has no longer any scientific foundation; in fact, it has no other solid foundation than *the real and never virtual constancy* of combinations, and *the real and never virtual invariability* of the proportions by weight of the elements which constitute them.

I do not conceal from myself that among the fundamental notions of chemistry there are a number, as in all other sciences, which we admit as demonstrated, but which are far from being so. Let us examine, then, how it is with the law of definite proportions. It rests on analysis and synthesis. These two data seem to leave no doubt even in the most exacting mind of the generally admitted law of the constancy of all combinations. But the constancy of composition of every combination does not prove that the relations in weight that their elements observe must be maintained absolutely in combinations with other bodies. Thus the composition of sulphide and sulphate of barium may be constant; but it does not follow from that that the relation by weight of sulphur to barium in the sulphide must be absolutely identical with the relation that these same bodies present to each other in the sulphate of barium. The fundamental character observed in certain double decompositions—that is to say, the *maintenance of the neutrality of the liquid* in which the reaction takes place, and which led Wenzel nearly a century ago to suppose the existence of a law—does not rigorously demonstrate that the relative proportions of the alkaline and earthy metals which replace each other in a given quantity of the same acid are the same for all acids, any more than a change in this neutrality demonstrates that the relative proportions are not the same.

The labours of Wollaston and Gay-Lussac, on which we have relied from the beginning of the century, never offer the degree of precision necessary to be able to deduce from them with certainty that the hypothesis of Dalton known as *the law of multiple proportions* is a *mathematical law*, and not simply a *limited law*.

When we weigh well all the reasons that have led chemists to consider the law of Wenzel and the hypothesis of Dalton as demonstrated truths, we are convinced that they are based rather on the constancy of composition in combinations than on a rigorous experimental demonstration of these laws. We may then question whether it is proved that compound bodies produced under the normal conditions of their formation do contain their elements in the exact proportions of the weights of their atoms. The moment the laws of chemical proportions are regarded as limited laws, the partisans of Prout's hypothesis may suppose, as M. Marignac does, that if the atomic weights determined by experiment do not exactly coincide with the hypothesis, the error arises from the compound not containing its elements in the exact proportions of their atomic weights. In this case we have no means of submitting Prout's law to an experimental verification. The determination of atomic weights equally loses the importance it had while we considered these weights as *natural constants*, because we have the certainty, *a priori*, that the most accurate experiment can only furnish us with *mean* or *limited atomic weights*, and not the true relations of the weights of atoms.

(To be continued.)

TECHNICAL CHEMISTRY.

The Manufacture and Properties of Aniline Colours, and the Bodies used in their Preparation, by MM.* Depoully *Brothers.*

I. Oils used in making Commercial Aniline.—The source which furnishes oils containing benzol and toluol is coal tar, which is produced in making coal gas.

In the distillation of these tars the first product is an oil lighter than water, commercially called "light oil," and containing—

1st. Neutral liquid hydrocarbides, benzol, toluol, cumol, &c., and a little solid hydrocarbide naphthaline.

2nd. Phenols, bodies holding at the same time both alcohols and acids, phenic and cresylic acids.

3rd. Very small quantities of alkaloids, aniline, picoline, quinoline.

To extract from these oils the principles used in making aniline colours, it is first necessary to separate the phenols; this result is obtained by agitating the oils with small quantities of caustic soda at 40° Baumé, or even more concentrated. If we separate the watery layer containing the phenols in combination with soda, this operation twice repeated completely frees the oils from phenols.

Sometimes, before this operation, the alkaloids are removed from the oils by being rapidly agitated with a small proportion of sulphuric acid.

* Memoir presented to the *Société Industrielle de Mulhouse* at the meeting of May 31, 1865.

These washings should be terminated before new rectifications are commenced, for the naphthaline separates much more readily by a redistillation when neutral oils are operated upon.

It then merely remains to separate the benzol and toluol from their homologues, the other liquid hydrocarbides.

We generally operate by fractional distillation—that is to say, by collecting all that is distilled between 80° and 120°, and thia portion is sold under the name of benzol, and serves in the making of aniline.

Benzol is usually sold with a standard of distillation fixed beforehand, either at 90 per cent. or 60 per cent.—that is to say, 90 or 60 per cent. distilling below 100° C.

During the last few years benzol at 90 per cent. has been most in demand, but it has lately been found that aniline made with benzol at 60° gives the greatest yield of colouring matters.

These benzols are composed almost exclusively of two bodies—benzine and toluol.

Benzine, $C_{12}H_6$, distils at 80°; treated by nitric acid it gives nitrobenzine $C_{12}H_5NO_4$, distilling at 213°, which by reducing agents gives aniline $C_{12}H_7N$, distilling at 182°.

Toluol, $C_{14}H_8$, distils at 114°; by nitric acid it gives nitrotoluol, $C_{14}H_7NO_4$, which forms toluidine, $C_{14}H_9N$, distilling at 198°.

In thia aeries of homologous hydrocarbides, benzol, toluol, xylol, cumol, cymol, the densities dimiminish in proportion as the equivalent and the boiling-point rise; and this law holds not only for hydrocarbides, but for their nitrogenised derivatives, for the alkaloids derived from them, and also for the corresponding phenols.

Thus a hydrocarbide distilling at 80° will have a density of 0·885; of another, distilling at 110° or 114°, the density will be only 0·870.

The density of a nitrobenzol distilling at 213° to 220° would be 1·200 to 1·210, while that of a nitrotoluol distilling at 220° to 230° would be 1·180 to 1·190.

Pure aniline, $C_{12}H_7N$, distilling at 182°, would have a density of 1·028; pure toluidine, $C_{14}H_9N$, distilling at 198°, would have a density of 1·001 to 1·002.

Phenic phenol, $C_{12}H_6O_2$, is denser than cresylic phenol, $C_{14}H_8O_2$.

Neither pure anilinenor pure toluidine produces colouring matter.

The best reaults, both as to beauty and quantity, and with both red and violet, have been obtained with a mixture of 70 per cent. of toluidine and 30 per cent. of aniline—that is to say, 2 equivalents of the one, and 1 equivalent of the other. These proportions agree perfectly with the formula aseribed by Dr. Hofmann to rosaniline. The object in view is then to obtain a commercial aniline thus composed.

The fractional distillation of commercial aniline for this purpose is a difficult operation. The distillation of nitrobenzol is not only dangerous, but expensive. It is better to endeavour to separate the hydrocarbides serving for the fabrication of aniline. Though this is not the usual operation, it appears to us the only rational one if aniline with an unvarying composition is desired.

The first method of aeparating hydrocarbides is due to Mansfield, who, in 1848 and 1849, produced the hydrocarbides of coal-tar and their derivatives, and indicated a great many applications for them. This work cost him his life. Proposing to separate benzol from the light coal oils, Mansfield heated these oils in a still with the head kept surrounded with water. The vapours ascending into the head became condensed, and fell back into the still; and after a time the water surrounding the head, not being renewed, was heated to the boiling-point. From the time the water in the open jacket reaches a temperature of 80° the benzole no longer condenses, but passes on into the worm, while the other oils fall back into the still. When the water arrives at the boiling point, only benzole passes over; after a time nothing passes, and all the benzolé is separated.

This complete separation is founded on the boiling-point of water, intermediate between that of benzol, 80°, and that of toluol, 114°.

Mansfield tried to separate only benzol. The operation might easily be modified so as to separate toluol in a similar manner; it would suffice, the benzol once separated, to replace the water by some liquid—a saline solution, for inatance—maintained at a constant level, and with a boiling-point intermediate between that of toluol and that of xylol.

Mansfield also tried to separate benzol with the apparatus used for the rectification of alcohol. Several patents have been taken out with the same idea, amongst which we will mention only M. Ch. Coupier's, who has effected the aeparation of benzol and toluol by means of an ingenious apparatus patented by him. We have aeen various products from his works at Poissy, consisting of pure benzol and aniline, and nearly pure toluol and toluidine.

Some researches, for the purpose of previously separating the oils of coal-tar in an exact and economical manner, are much required, and would lead to great progress in the fabrication of aniline colours.

Another reason for insisting on this point is the considerable difference in the manner in which toluol and benzol behave with regard to nitric acid, when it is desired to transform them into nitrobenzol.

Toluol is attacked with greater difficulty; mixtures of sulphuric and nitric acids must be modified before treating this body.

In this series, in proportion as the equivalent is raised, the action of nitric acid becomes more violent, especially more oxidising, more destructive, forming nitrogenised bodies more easily; indeed, great precautions are necessary in obtaining nitrogenised derivatives from the higher hydrocarbides.

Here, then, is a cause of loss, and of the formation of secondary products. In a mixture of benzol with other oils, there is a risk of destroying a part of these oils or of leaving part of the benzol unattacked.

Moreover, is toluol a perfect homologue of benzol? The action of chlorine on these two bodies is not the same; with benzol it produces chlorides without eliminating hydrogen; with toluol it produces chlorinated toluols, the chlorine substituting itself for one or more atoms of hydrogen.

(To be continued.)

PHARMACY, TOXICOLOGY, &c.

On the Mutual Action of the Elements of Soluble Salts without and within the Animal Economy, by M.* Melsens.

The experiments already made by the author, he considers, justify him in formulating the following proposition:—

Two soluble salts which are without apparent mutual action, and which may be given separately to animals

* *Bulletin de la Soc. Chim. de Paris*, July, 1866. Abstract from the *Bull. de l'Acad. Royale de Belgique*, 1866.

without producing any disturbance in the body, may, when administered together, act as a poison.

Facts of this kind, proved by experiment, have a great importance, both from physiological and therapeutical points of view.

The two salts more especially experimented with by the author are chlorate of potash and iodide of potassium. These two salts in solution together crystallise separately under whatever conditions they may be placed. Their mixture in solution in equivalent proportions undergoes no mutual decomposition either at the ordinary temperature, on boiling, or under the pressure of 10 atmospheres at 185° C. It can be proved by means of sulphydric acid that no iodate of potash is formed.

But when the two salts are heated together in the dry state, decomposition takes place at the point of fusion, and iodate of potash is formed.

When a certain quantity of mineral acid is added to a mixed solution of the two salts, iodine is set at liberty, and the solution behaves towards sulphydric acid as though iodic acid had been produced.

When the mixed solutions are submitted to electrolysis, hydrogen is disengaged at the positive pole, and the liquor appears to contain both iodide and iodate.†

We come next to the effects of the before-mentioned salts on animals. Seven grains of chlorate of potash were given to a bitch weighing eleven kilos. every day for a month; the animal did not at all suffer. Afterwards five grammes of iodide of potassium were given daily for the same period. The animal suffered a little during the first days, but at the end of the month was perfectly well.

If, on the contrary, we administer to a dog daily seven grammes of a mixture of iodide of potassium and chlorate of potash in equivalent proportions, the animal languishes and dies about the twenty-fifth or twenty-eighth day. On commencing the experiment one dog weighed 16·5 kilos., at the moment of its death it weighed only 11·5 kilos. The experiment repeated on several dogs gave similar results. Death often supervened about the fifth day.

Post-mortem examinations revealed changes similar to those observed by the author when iodate of potash was administered, especially in the liver and intestines, but it is necessary to make a series of comparative experiments with the iodate, free iodine, and mixtures of the two salts.

The author has shown in previous memoirs that the iodate of potash acts as a poison. This salt, given in doses of one or two grammes daily, will kill a small dog in a few days. A mixture of the two salts cannot be so active as the iodate, since both unchanged iodide and chlorate may be found in the urine. The author is therefore brought to the conclusion that the mutual action of the two salts in the economy takes place with the greatest facility. It may be supposed that the acids of the stomach and the electrolytic actions which take place in the organism play an important part in bringing about this decomposition. But beyond all hypothesis it is necessary to admit that changes take place in the animal system which cannot be realised in the laboratory under ordinary conditions, or with the assistance of a high temperature, strong acids, or even the electric current.

† To avoid the action of chlorine, iodine, and oxygen, the author employed retort coke as the positive electrode. The carbon was previously treated with aqua regia, and then ignited in a current of chlorine. The carbon employed in the above experiment was disaggregated, and in part burnt to carbonic oxide and acid, and at the same time a soluble black carbonaceous matter was obtained, similar to the ulmic product which the author obtained by the action of chlorine on the carbon contained in the lungs in *melanosis*.

PROCEEDINGS OF SOCIETIES.

ROYAL SCHOOL OF MINES, MUSEUM OF PRACTICAL GEOLOGY.

A Course of Twelve Lectures on Chemical Geology, by Dr. Percy, F.R.S.

Lecture No. VIII.

I have some further remarks to make concerning the sulphides. Having made them, I shall proceed to consider the subject, coal.

I was speaking to you, on the last occasion, of the sulphide of lead, galena, and I showed you a specimen of it beautifully crystallised by the agency of heat alone. I also gave you, I think, conclusive reason to infer that sulphide of lead may be crystallised, and very well crystallised too, by the action of liquids. The proof consisted in the fact of galena occurring in nodules of clay iron ore —a condition under which it is impossible that it can be the result of igneous action.

There are one or two other points concerning tha sulphide of lead which are very interesting. I refer to the constant association therewith of certain very important metals: I mean silver and gold. It may be laid down as a universal proposition, without any exception so far as is known, that all galena contains silver—*all*. There are varieties which contain a very small quantity of silver, and which are therefore said to be "poor:" still, if search be made for the metal, even in the poorest kinds you never fail to obtain not only traces, but far more than traces, of silver. The silver in the sulphide of lead must, of course, exist as sulphide of silver. Galena is a source of a very large supply of silver in different parts of the world. It may be laid down also, not merely as a general rule, but, I believe, as a universal proposition, that all galena contains gold—*all* galena. Some years ago my friend on my right, Mr. Smith, and myself set to work to examine this point, and we made a great many determinations with respect to the presence of gold in the ore of lead and in various commercial compounds of lead. Forty specimens or more were examined, and every one yielded palpable, visible, unmistakable traces of gold. Still, the quantity of gold is so small as to be utterly worthless in a commercial point of view. Here are the evidences of these facts. Every single specimen of gold extracted in these experiments has been carefully preserved in hermetically sealed tubes, and the condition specified. It requires rather careful manipulation. In these experiments there was no possibility of error. There was nothing added in the way of chemical re-agent, which might vitiate the result. The process consists of taking the compound of lead and simply submitting it to the well-known operation called cupelation by which silver is extracted from lead. There remains behind a very small globule of silver, and in that globule we are enabled to detect the gold by the simple action of a solvent of silver, nitric acid, which leaves the gold. It has to be taken up with great care and transferred to a piece of blotting-paper. It is afterwards gummed on to a piece of paper and then burnished, when the characteristic colour of gold immediately appears. It is a remarkable circumstance not only that gold is detected in the ore of lead, but also in the various commercial compounds of lead—white lead, red lead, sugar of lead: nay, we have even gone farther, and found it in lead fume, that is, the smoke that is volatilised from lead in the process of its extraction. We may, then, I think, safely conclude that lead contains always silver and gold. Perhaps you may object to the deduction with regard to gold as not being sufficiently supported. It is founded on forty examinations under various conditions. At all events the proof is strong, if not conclusive.

The next sulphide to which I will advert for a few moments is one of great importance. It is sulphide of zinc. It is called blende, from the German word signifying

to dazzle by light. It is a compound of sulphur and zinc in the proportion of atom for atom. It is to be seen in mineralogical cabinets presenting various colours and magnificently crystallised. Here, in this specimen, it is of a dark colour, but that is owing to the association of other matters. Sometimes it is light brown, and very rarely it is found perfectly colourless. I have seen only one or two specimens of white, colourless blende, and then only in small quantity. As thrown down from solution it forms a white powder. Here is a solution from which we can obtain it. You see it there goes down as a white precipitate, which might be collected in a filter, washed, and then dried. Now, that is the pure sulphide of zinc. It is very difficultly fusible. When heated for a long time to a high temperature it contracts very much and becomes to a certain extent fused, but not perfectly so. It is a fixed body. You may expose it to almost any degree of heat you like in a close vessel, and it will remain without being volatilised—at all events in sensible proportion. I know that it may be volatilised, but under special conditions—not under those to which I now direct your attention. Practically speaking, it cannot be volatilised. We can form sulphide of zinc (this is the point of geological interest) by heating sulphur and zinc together; but then there is a difficulty. The sulphur is very easily volatilised, and the zinc easily burns; and the misfortune is that sulphide of zinc is very infusible. Hence, what is done by this attempt to form sulphide of zinc by direct combination is to produce a sulphide on the surface of the solid zinc, which protects the mass beneath from further combination. In most other cases the formation of sulphide by direct means is not so difficult, because the sulphide very easily melts. There can be no doubt, from the same reason which I have given with regard to sulphide of iron, that in nature sulphide of zinc has been generally, if not always, produced by aqueous action. If we inspect mineral lodes containing sulphide of zinc, we may be quite certain, from the association of other minerals, that igneous action of itself could not have been employed, and that the compound has been generated by liquid reagents. Take, for example, the case of clay iron ores—a very simple and homely illustration indeed. In these ores we frequently find sulphide of zinc. Here it is, in the very centre of one of these specimens, which, I have said over and over again we have certain proof, can only have been produced by aqueous agency. Sometimes we find a large mass or nodule of clay iron ore, and it shall present numerous radiated fissures or cracks, and in the cracks of that nodule we shall find this blende; and you will always find it on the exterior first—a mass here and there. It may creep on to the very interior, but sometimes you find it confined to the exterior, showing clearly that the blende has been introduced into that globule through the agency of liquid reagents *from without*. No evidence, I take it, can possibly be clearer than that.

We will take next copper pyrites. This is a well-known mineral, and one of the most important with reference to the production of copper. It is a yellow mineral, sometimes mistaken for, and confounded with, iron pyrites, yet very different indeed from the latter. We have very fine specimens of it in the Museum, which you can examine at your leisure. We may regard this copper pyrites as composed of one equivalent of bisulphide of copper, and one of sesquisulphide of iron, $CuS_2 + Fe_2S_3$. The bisulphide of copper is the compound which is produced when copper and sulphur are heated together, and which is represented by the formula CuS_2. Copper pyrites, which is accurately represented by the formula I have given, contains, when pure, about 34 per cent. of the metal. There can be no doubt that copper pyrites has been formed in nature, frequently at all events, by aqueous action. We find it frequently in the nodules of clay iron ore. When we examine mineral lodes, metalliferous veins, we may be quite certain that the copper pyrites frequently found therein has been the result of aqueous action only. I do not mean to say that under special circumstances it cannot have resulted from igneous action, but I do say that in most instances liquid reagents have been concerned in its formation. Now for the proof. For this we are indebted to Senarmont. He made it by heating at 250° Centigrade a mixture of protochloride of iron and chloride of copper with a solution of persulphide of potassium in insufficient quantity to decompose the chlorides, and with a great excess of carbonate of soda. He obtained it by this means in a crystallised state.

I might call your attention to various other sulphides. Here is one of great interest in a mineralogical point of view, also found in our clay iron ore. It is that delicate hair-like stuff which you see here. It is sulphide of nickel. It is called millerite, after Professor Miller, of Cambridge. There is no doubt that this has been formed by the agency of liquids.

Now, be careful not to mistake what I have said with regard to the formation of these sulphides. I am not prepared to say that Nature has resorted exclusively to one mode of formation. She has doubtless availed herself of other modes than one; but there is no doubt whatever that in the majority of cases—with regard, for example, to the ordinary sulphides, iron, copper, lead, and zinc—she has employed aqueous agency for their production. I shall have more to say with respect to iron pyrites when I come to deal with the subject of iron, which I shall bring before your notice in the course of another lecture or so. So much, then, for these general remarks concerning the sulphides.

We will next take up a subject of high interest, especially at the present day: I mean that of coal. We shall consider the nature of coal, its composition, its varieties, its mode of occurrence, and other circumstances connected with coal.

In the first place, there is no doubt whatever that all coal has been derived from vegetable matter of some kind or other. The geological proof is amply sufficient to justify this conclusion. No one doubts it now. We find frequently, either in coal itself or associated therewith, the remains of the identical plants which have concurred in its formation. We can trace the formation of coal step by step from woody tissue on the one hand, to anthracite on the other hand, which is most removed from wood in composition; and on the lecture table I present you with a large series of specimens illustrating the transition as perfectly and gradually as one might desire.

I shall begin on this occasion with the consideration of the matter from which coal has been produced—woody tissue—and then proceed gradually till we get to anthracite, which, I say, is farthest removed from coal, consisting principally of carbon. After that, we shall take up the subject of graphite, a variety of carbon termed an allotropic variety, and we shall conclude by a consideration of the diamond. I am indebted to my friend Professor Tennant for a very beautiful series of illustrations of the diamond, some of which are here.

You will allow me, then, to take it for granted, without further question, as you may with reason, that coal has been formed from vegetable matter. The essential tissue of which all plants are composed is the same. It has the same chemical composition, whether we take it out of lignum vitæ or willow wood. The fundamental tissue of which the plant consists is essentially the same, and is identical in all respects wherever we find it. You will say, "But is not one wood different from another?" Doubtless it is, but that is due, not to a difference of composition in the tissue, but to the association of other matters with that tissue; and hence the variety of all the wood we find in nature.

This vegetable matter, or woody tissue (I will henceforth use that expression, woody tissue) consists essentially of what is termed organic matter (cellulose organic

matter, if you please) and water and ash, this ash being certain saline ingredients. Now, we can take the tissue, and deprive it completely of this water and of the ash. We are therefore justified in regarding the water and the ash as nothing more than mechanically present. You all know that if you take a piece of wood, ignite it, and burn it completely, an ash always remains, generally containing more or less of charcoal from imperfect combustion. That ash, I say, consists of certain saline ingredients which are always present in wood. Potash, silica, and lime may be regarded as the chief constituents. All tissue contains hygroscopic water: by that I mean water which is contained in the wood just as water is contained in the pores of a sponge. You can displace that water from the wood by just exposing it to a gentle heat. Then the wood, upon being exposed to the atmosphere, will reabsorb the water. The driest table or piece of furniture contains about 18 per cent. of this mechanically associated water. The cracking of furniture is due to the variation of the quantity of water, corresponding with certain variations of the temperature of the air. You will see the bearing of this, because I shall show you that certain varieties of coal are very analogous to wood in this property of containing hygroscopic water — the water which I told you is always mechanically present. Wood, when freshly felled, contains a much larger quantity of water than wood which has been felled a greater length of time. Under certain conditions fresh wood contains quite half its weight of water. There are many kinds of wood used for mechanical purposes, many of which are quite familiar to you, but I have not to deal with these things specifically, but generally.

Now, all wood consists essentially of carbon, hydrogen, oxygen, and a little nitrogen. Then there is the ash and the hygroscopic water. I have made a calculation from a great number of careful analyses of wood made by French and German observers, and have got the mean result from two extensive series. The results do not exactly coincide, but still they are sufficiently near for our purpose. It is important that you should note the composition of this woody tissue, because it is the source of all our coaly matter. Here is the mean composition, calculated from the experiments to which I have referred:—

	Per cent.
Carbon	51·215
Hydrogen	6·237
Oxygen	41·449
Nitrogen	1·098
Ash	1·772

Such, then, is the ultimate composition of all woody tissue. You will find by calculation that the hydrogen is practically a little in excess of the oxygen. I say practically. I do not mean to say theoretically; but regarding the oxygen here as in combination wholly with the hydrogen. I do not mean for one moment to say that it is actually so in the wood, but for our purpose we may so regard it. This being the case, then, wood may be regarded as composed of carbon plus water, and a little hydrogen in excess. Now, it is a singular thing that in burning that wood and estimating the whole of the heat evolved therefrom by perfect combustion, as we can readily do by means of the apparatus called the calorimeter, we find actually that all this oxygen is combined with a corresponding amount of hydrogen—that is to say, an atomic proportion, or may be so regarded. It there represents so much water, and therefore causes a great loss of heat; because in the burning of that wood the whole of that water, which is there in a solid state, has first to be liquefied, and then to be converted into vapour. Now, this is a practical remark which applies to all fuels, and is of great consequence commercially and economically. Generally speaking, just in proportion to the amount of oxygen present in a fuel, it is deprived of heat-giving power, for the simple reason that that oxygen may be regarded as so much water, being combined with hydrogen, a little hydrogen always being in excess. We get, then, in the burning of wood, heat simply from the combustion of the carbon present.

With regard to the nature of the ash I do not think I need trouble you. There are many analyses given, but they are not so satisfactory as might be desired. Potash, for example, is obtained by the incineration of woody matter, hence the name of "potash." Then there is soda present, especially in plants dwelling near the sea. There is lime also in large quantity, and magnesia. Alumina is a doubtful thing. It has been found, or is said to have been found, but possibly there has been an error in the determination. It is difficult to understand how the alumina could get into the plant. The potash in the wood ashes is combined with carbonic acid, but this base is not so combined in the tissue of the plant itself. Then there is also a little phosphoric acid.

A great deal of high interest might be said of the rapidity of the growth of wood, but I have hardly time to dwell upon that point now.

From wood we pass on to peat. That is the first step in the conversion of wood into coaly matter. I do not mean to say that it is the first actual step, because between wood on the one hand, and peat on the other, there is a pretty wide difference; still that is the first decided step. I could supply you with a series of specimens illustrating the transition perfectly. We go to a peat bog and examine it: the upper part of the bog is covered with moss, chiefly of the order called sphagnum, a very beautiful kind of moss. This goes down lower and lower, and is gradually decomposed and converted into a substance called peat. This peat consists of the identical woody tissue—cellulose—which occurs in large trees. Now, considering the growth of a moss like this, diving downwards as it extends upwards, you can conceive there is a complete transition from the unchanged moss at the top right away down to the carbonised and black stuff forming peat at the bottom. Hence, in the examination of a peat bog, you will always find that the upper part will be the least removed from the woody tissue in composition, and that which occurs deepest in the bog will be most decomposed, farthest removed from wood, and most allied to coal. These peat bogs we find not only in our own country, and in other parts of Europe extensively, but even in hot and tropical regions—there not generally on the surface, but up high hills where we get a climate resembling that of Scotland. In North Carolina there is a large quantity of peat occurring, according to Sir Charles Lyell, to the depth of fifteen feet or so. There is one point of interest with regard to the source of peat. While that which is found in Europe has been derived almost entirely from mosses—these sphagnums, associated, it is true, with a variety of other plants, but only to an insignificant extent—the peat in India has been, in several cases at all events, formed from plants of a totally different nature. According to my late friend Dr. Falconer, peat occurs on the banks of the Hooghly, at Calcutta. These peat bogs occur in various parts of India. I have here a statement taken from the *Journal of the Asiatic Society* of Bengal concerning peats in Bengal derived entirely from the wood rice or *Oryza silvestris*. I have here a peat from the Neilgherry Hills in India not formed from mosses: it is important to bear that in mind. We have, as every one knows, very large deposits of peat in Ireland. That peat has been carefully examined under Sir Charles Keen's direction, and the result published in a blue-book. On comparing his analyses together, we get, first of all, the least changed kind of tissue, which has very nearly the composition of woody tissue before the process of decomposition commences, and then we have a gradual series of peat until we come to that which is most changed and most removed from woody tissue, and nearest in its resemblance to coal. This is called brown coal, of which I will speak hereafter.

The ash of peat contains, as you might expect, the same elements, for the most part, as the ash of ordinary plants. Still, there are certain differences. Consider the mode in which the peat bog is formed, then the rushing in of water from time to time, streams flooding it, and so on, and the carrying in of various matters by these sometimes turbulent streams—such as sand, clay, and other things foreign to the peat itself. You can easily see how peat may thus get intermingled with a large amount of what may be perfectly well called foreign matter. That has a very important bearing especially in relation to the association of copper and other mineral matters. There was a peat bog in Wales some time ago, in which a large quantity of copper was found and profitably extracted. Iron pyrites was also met with.

You know the antiseptic property, or preserving power, which peat has—how pieces of wood have been preserved by it, though darkened in colour.

Peat contains water, as water is contained in a sponge, which may be expelled either by pressure or by desiccation.

(To be continued.)

ACADEMY OF SCIENCES.

August 6.

M. P. Truchot presented a note "*On the Combinations of Chlorhydric Glycide with Acid Chlorides and Anhydrous Acids.*" A mixture of epichlorhydrine and acetic chloride heated for thirty hours to 100° in a sealed tube yields two new bodies, which can be separated by distillation under pressure. The first is the *acetotrichlorhydrine* of diglyceric alcohol, and the second the *acetoquadrichlorhydrine* of triglyceric alcohol. By heating chlorhydric glycide and anhydrous acetic acid in the same way to 200°, diacetochlorhydrine was obtained.

The same author presented a note "*On the Oxidation of the Radicals of Diatomic Alcohols by Permanganate of Potash.*" Ethylene, the author states, and its homologues decolorise a solution of permanganate, and give rise by direct oxidation to acids of the series of fatty acids. A carbide C_nH_{2n} gives all the fatty acids corresponding to the terms below it in the series. At least, the author thinks he may safely conclude so, from his experiments with ethylene, propylene, and amylene. With ethylene he obtained formic acid; with propylene, formic and acetic acids; and with amylene, formic, acetic, propionic, and butyric acids. In each case the author proved the absence of the acid corresponding to the carbide of hydrogen employed. In these experiments crystallised permanganate was employed, an excess of alkali being objectionable.

M. C. Davaine presented a note "*On the Rotting of Fruits.*" The natural rotting of fruits, the author states, is due ordinarily to the development of two microscopic fungi, *Mucor mucedo* and *Penicillum glaucum*. The thicker the epidermis of a fruit, the longer it will keep. The author points out some difference in the progress of the change under the influence of the two fungi; that produced by *Mucor* being much more rapid than that set up by *Penicillum*. The whole paper is of considerable interest to naturalists.

NOTICES OF BOOKS.

Bulletin Mensuel de la Société Chimique de Paris, &c., &c. July, 1866.

The proceedings of the Chemical Society of Paris at the last two meetings do not offer much of interest. M. Berthelot on June 15 described the experiments on the action of sodium and potassium on the carbides of hydrogen, which we have already laid before our readers. It will be remembered that the carbides experimented with were only attacked by the alkaline metals at a red heat. In sealed tubes they may be fused under benzine without any gas being disengaged, and the metals will preserve their metallic lustre for any length of time. M. Berthelot points out a source of error in all experiments of the kind made with potassium. However short a time this metal may be exposed to the air, a small amount of carbonate is formed on the surface, and the decomposition of this produces a small quantity of acetylide.

On July 6 M. Melsens, of Brussels, communicated an important note "*On the Mutual Action of Chlorate of Potash and Iodide of Potassium within the Animal Economy.*" It will be found at length in another place. Chemists and medical men are too apt to regard the human stomach and organism as a sort of laboratory, the processes going forward in which are to be as easily controlled and directed as those carried on in beakers and flasks. In this paper, most important to physiology and therapeutics, M. Melsens shows that two salts which have no action on each other without the body do react when introduced into the animal economy. Whether there is such a thing as *vital force*, which here becomes superadded to chemical force, or whether the reaction can be accounted for by the more intimate contact into which the salts are brought in the course of their passage through animal membranes, we must leave for the present to conjecture.

On July 6 M. Berthelot addressed the Society on the subject of M. Stas' last determinations of atomic weights, and gave his reasons for believing them to furnish a conclusive answer to the objections raised by Marignac to the first series. In the introduction by M. Stas, the publication of which we commence in this number, our readers will see the answer of M. Stas himself, and will probably agree with M. Berthelot in regarding it conclusive.

We give here the titles of the papers presented to the Society now published: "*On Isomerism in the Allylic Series,*" by M. A. Oppenheim, and "*On Allyl-ethylic Ether,*" by the same author. The former paper we have already noticed; in the second the author mentions that when allyl-ethylic ether is treated with a strong solution of hydriodic acid, iodide of allyl, iodide of ethyl, and water are produced.

The usual analysis of foreign papers contains a number of useful abstracts from the German journals. We give the titles of the more important: "*On Erbia and Yttria,*" by MM. Bahr and Bunsen; "*Researches on Tantalum, Niobium, and Ilmenium,*" by R. Hermann; "*On the Tantalic Group,*" by M. Bloxam (probably a misprint for Blomstrand); "*On Sulphocyanacetic, Thioglycolic, and Thiodiglycolic Ethers,*" by Heintz; "*Researches on the Aromatic Combinations,*" by Kékulé; "*On some Substitution Products of Phenylic Alcohol,*" by Koerner; "*On some Substitution Products of Benzine,*" by A. Mayer; "*On some Sulphuretted Derivatives of Toluene,*" by C. Maercker; "*On a New Class of Organic Compounds in which Hydrogen is replaced by Nitrogen,*" by P. Griess. The shorter notices will furnish us with a few miscellaneous paragraphs. Two errata in the memoir of M. Weltzien "*On Peroxide of Hydrogen and Ozone,*" one of which was transferred to our pages, are here corrected: at page 39, line 29, column 2, for "*does not ignite spontaneously inflammable phosphuretted hydrogen,*" read "*ignites non-spontaneously inflammable phosphuretted hydrogen.*" The second erratum was so obvious that we corrected it in our translation.

Journal de Pharmacie et de Chimie. July, 1866.

This Journal contains a paper, by M. Leon Soubeiran, "*On the Mineral Substances of the Chinese Materia Medica.*" It is accompanied by a plate giving the Chinese characters and names for all the remedies. A note, by M. J. Nicklès, "*On the Pretended Wide Distribution of Copper,*" points out that the source of traces of copper in ashes is often the Bunsen's burner used for the incineration, and of course suggests that only the steatite burner should be employed

in these operations. A note, by M. Filhol, "*On the Preparation of Medicinal Tinctures,*" contains an observation or two which may be worthy of attention. The author notices that tinctures prepared by displacement give, in a day or two, a deposit which may or may not be inert matter, but which deserves an examination. He remarks, also, that the density of a tincture is no certain test of its value, which should be determined by the amount of active matter in solution. According to M. Filhol, alcohol is not so good a preserving agent as is generally supposed, and tinctures ought to be used as soon as possible after their preparation. There are some other remarks which, coming from such an authority as M. Filhol, may deserve the attention of pharmaceutists, and we shall give the note at length.

A number of papers from the *Comptes Rendus* follow, which we need not notice.

The usual Pharmaceutical Review contains a short paper "*On Crystallised Citrate of Magnesia,*" by M. Morelli. The author mixes proper proportions of crystallised citric acid and freshly precipitated carbonate of magnesia with a small quantity of water, and stirs frequently. When, he says, the carbonic acid ceases to be disengaged, the whole is suddenly transformed into a crystalline mass resembling moist barley-sugar, which has only to be dried. The mass is composed of small crystals, which easily dissolve in four times their weight of water. The salt has an acid taste, and forms an agreeable drink with a little flavoured syrup.

There is also a note by Dr. De Vrij "*On the Purification of Quinoidine.*" Commercial quinoidine contains a good deal of lime, which the author removes by boiling with a solution of oxalate of ammonia. The quinoidine dissolves and ammonia is disengaged, the foreign matters falling to the bottom. The solution is poured off, diluted if necessary, and filtered, and the quinoidine is then precipitated by means of caustic soda, drained, and dried.

A note by M. Stanislas Martin "*On Liquid Kino*" recommends pharmaceutists to buy only the liquid juice and evaporate it for themselves. The solid extract, the author states, is adulterated with catechu.

The next paper is by M. Besson, "*On Liquid and Dried Pepsine.*" The author states that in the course of drying pepsine loses the greater part of its digestive power, and details an experiment which goes to prove the assertion.

The proceedings of the Paris Pharmaceutical Society offer but little of interest. M. Rouher made a communication "*On the Blue Colouring Matter of Urine, Urocyanine,*" which he isolates by adding to the urine first its volume of alcohol, and then one-fifth of sulphuric or hydrochloric acid. Chloroform shaken up with the mixture removes all the colouring matter, forming a pure blue or violet solution. It is better in the first place to treat the urine with subacetate of lead.

M. Robinet told the Society that it was better to use pounded glass than shot in cleansing bottles.

The usual abstracts from foreign journals contain a few notes which we transfer to our miscellaneous columns.

Annalen der Physik und Chemie. No. 5. 1866.

This number of Poggendorff's *Annalen* is mainly devoted to physics. We have, however, "*A Contribution to the Knowledge of Axinite,*" by G. Vom Rath; a short paper "*On the Behaviour of Glauber Salt Solution at Low Temperatures,*" by Dr. F. Lindig; a paper "*On the Composition of Wiserin,*" by Dr. Wartha; "*On Isomorphous Mixtures of Perchlorate and Permanganate of Potash,*" by Rammelsberg; and "*On Crystallised Sulphide of Sodium,*" by the same author. We have a paper by Bunsen, "*On the Absorption Spectrum of Didymium,*" illustrated by excellent diagrams; and also a learned contribution by C. Eckhard "*On Hydrodiffusion through Animal Membranes.*"

NOTICES OF PATENTS.

Mr. Isham Baggs' (No. 2719, Oct. 21, 1865) patents "*Improvements in the Manufacture of Inflammable Gases and in their Application to Useful Purposes.*" The inflammable gas is hydrogen, which is produced by passing steam over red-hot iron. The oxide is then reduced in the following way:—

"Carbonic acid gas, however derived or produced, is passed through or over red-hot or ignited coke or carbon, arranged in suitable retorts or receptacles (as is well understood by persons acquainted with such operations and with the chemistry of the gases and the materials in question), and the same is then conveyed through the retort or vessel containing the oxidised iron, from which retort or vessel the hydrogen has been eliminated. The result of this operation is that one volume of carbonic acid gas in passing through or over the ignited coke or carbon takes up an additional equivalent of the latter, and is thereby converted into two volumes of carbonic oxide gas, which latter gas then passing on through the retort or vessel containing the oxidised iron takes up the oxygen from the same, and is thereby again converted into carbonic acid, restoring at the same time the iron to its normal or metallic condition, capable of decomposing steam again."

This is another case of patenting well-known chemical processes.

Carl Gustav Lenk (No. 2674, Oct. 17, 1865) patents "*An Improved Process for Purifying and Preserving Water.*" This is a combination of well-known processes. The inventor makes use of a solution of alum and carbonate of soda, and a solution of iron or permanganate of potash, and adds such a mixture to the water. What the patentee hopes to secure it is hard to see.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

Notices to Proceed.

927. R. Hinson, Manchester, "An improvement in aerated waters."—Petition recorded March 31, 1866.

941. E. Brooke, jun., Huddersfield, "Improvements in the construction and arrangement of apparatus and material for effecting the deodorising of noxious gases arising from sewers and drains, and for the more effectual ventilation of such sewers and drains."—April 2, 1866.

952. J. Robey, Newcastle-under-Lyne, Staffordshire, "Improvements in reburning animal charcoal."—April 3, 1866.

959. W. Betts, City Road, Middlesex, "Improvements in colouring capsules."

960. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the treatment of sugar."—A communication from F. J. Chauvin and F. M. Légal, jun., Paris.—April 4, 1866.

1049. A. Swan, Kircaldy, Fife, "Improvements in apparatus for evaporating or recovering lees."—April 13, 1866.

1102. R. Hamilton, St. Helen's Place, London, "An improved composition for coating or covering ships' bottoms and other surfaces subjected to the action of seawater."—A communication from J. Beeston, Table Bay, and J. Spence, Cape Town, Cape of Good Hope.—April 19, 1866.

MISCELLANEOUS.

Death of Mr. Hadow.—It is with much regret that we announce the death of Mr. Edward Ash Hadow, for many years Demonstrator of Chemistry in King's College, London. Wholly absorbed in the study of chemistry, Mr. Hadow was personally known to but few who had not the advantage of his assistance in the laboratory. But his labours in photography, and his admirable researches upon

the composition of gun-cotton and the platinum bases, will secure for him a wide reputation. As yet the scientific public have not had full opportunity of judging of the value and extent of his researches respecting the conatitution of the platinum salts, for these were embodied in a paper and presented to the Chemical Society only a few weeks ago. While his colleagues lament the loss of a much-esteemed friend, we feel that death has deprived the science of chemistry of one whose singular devotion to its study, and whose clearness and originality of thought and mature experimental knowledge, promised to do much for its advancement. Mr. Hadow died of pleuropneumonia on the 11th inst., after a prolonged illness, in the 35th year of his age.

Nitroleum, the New Substitute for Gunpowder.—A highly interesting official report has just been made by Colonel Shaffner of a series of experiments conducted by him at Washington, for demonstrating the use of nitroleum (which it should be explained is the new and far preferable name by which the Colonel designates the compound which has hitherto been called nitro-glycerine) in the explosion of mines. The results fully confirm the fact that the explosive qualities of nitroleum are far in advance of gunpowder. Two similar cast-iron pieces, weighing each 300 lbs., had a hole one inch diameter and fifteen inches deep bored in them, and were charged one with powder and the other with "nitroleum." The powder discharged through the fuse-vent three-sixteenths inch diameter did no injury. The nitroleum tore the iron to pieces, the force extending downward from the bottom of the charge, leaving a cone with its apex at the bottom of the drill-hole. Four musket-barrels were placed in wrought iron cylinders, two filled with gunpowder and two filled one-third full with nitroleum. The musket-barrels charged with powder were exploded by electricity; they burst open, tearing the iron to pieces. The explosion of the barrels charged with nitroleum produced a very different effect; they were flattened, and not so much broken to pieces; the force was so sudden and great that after the barrel had irregularly broken up and down the iron appeared like rolled plate—even and polished. The experiments appear to demonstrate that nitroleum can, with ordinary precautions, be handled and employed without greater danger than is common to gunpowder, and for blasting operations, at least, it presents undoubted advantages.—*American Artisan.*

Composition and Quality of the Metropolitan Waters in July, 1866.—The following are the Returns of the Metropolitan Association of Medical Officers of Health:—

Names of Water Companies.	Total solid matter per gallon.	Loss by ignition.*	Oxidisable organic matter.†	Hardness.	
				Before boiling.	After boiling
Thames Water Companies.	Grains.	Grns.	Grains.	Degs.	Degs.
Grand Junction	17·49	0·70	0·60	13·0	2·5
West Middlesex	16·77	0·80	0·76	12·5	2·0
Southwark & Vauxhall	17·10	0·58	0·49	13·0	3·5
Chelsea	16·60	0·68	0·60	13·0	2·5
Lambeth	18·39	0·75	0·72	13·0	2·5
Other Companies.					
Kent	27·86	1·00	0·02	18·0	8·5
New River	17·16	0·90	0·20	13·0	3·0
East London	18·16	0·80	0·40	13·5	3·5

* The loss by ignition represents a variety of volatile matters, as well as organic matter, as ammoniacal salts, moisture, and the volatile constituents of nitrates and nitrites.

† The oxidisable organic matter is determined by a standard solution of permanganate of potash, the available oxygen of which is to the organic matter as 1 : 8; and the results are controlled by the examination of the colour of the water when seen through a glass tube two feet in length and two inches in diameter.

H. Letheby.

The analysis of the metropolitan waters during the month of July shows that in every case there is less than the average proportion of saline and organic matters, and the reduction of the latter, which is the most important constituent of potable water, is most marked in the waters derived from other sources than the River Thames; for while the amount of organic impurity in the latter has ranged from 0·49 to 0·76 of a grain per gallon, that of the former has been from 0·2 to 0·4 per gallon. Indeed, the quantity of organic matter in the Kent water has fallen from an average of 0·2 of a grain to 0·02, that of the New River from 0·46 to 0·2, and that of the East London from 0·53 to 0·4. These reductions in the quantity of organic matter are chiefly due to the care with which the processes of filtration are conducted; and if these analytical results are compared with those of a few years ago, the improvement is still more remarkable. It is very probable, however, that the most perfect processes of purification, so far as they can be used at the works of the water companies, will never be sufficient to insure such a purity of water as the complete removal of those subtle agents of disease, which even the most refined appliances of the chemist have failed to discover. It may, therefore, well be that all discoverable traces of organic matter may be removed from water, and yet it may still contain enough of the minute germs of disease to manifest its morbific action wherever it is used. Experience, indeed, teaches us that it is not the quantity of organic matter in water so much as its quality which determines its dangerous properties; and if it is true, as modern pathological science has almost demonstrated, that the real agent of such diseases as infectious fevers, cholera, the rinderpest, and other allied zymotic maladies, are living germs, and not a gas, or vapour, or dead organic miasm, it must rest with the physiologist, rather than with the chemist, to decide on the means which are best suited for their destruction; and it is more than probable that the chemist would be putting forward very dangerous propositions, if by relying on his science alone he ventured to dogmatise on so difficult a subject. That which has been abundantly proved in respect of smallpox and some other infectious diseases is very applicable to the present inquiry in so far as it relates to the more than possible existence of choleraic germs in the water we drink. The agents of those diseases are unquestionably living germs, capable of remaining dormant for an uncertain, but nevertheless not indefinite period, and then springing into activity and multiplying themselves without limit, directly they find the condition necessary for their active development. But whether these germs are susceptible of oxidation, like common dead organic matter passing through its final stages of decay, is more than chemical science alone can determine. The analogies in physiology are against such a supposition, and they warn us not to receive it even as a possible fact. That which we do know, however, is that these germs are destroyed by the temperature of boiling water; that they are killed by all caustic substances, as chloride of zinc, chloride of iron, &c.; and that they cannot resist the action of certain agents, as sulphurous acid and its salts, carbolic acid, which act on them after the manner of specific poisons. We must, therefore, look to these agents rather than to processes of oxidation for reliable prophylactics; and in the case before us, the only agent on which we can confidently rely is heat; for if the infected water be boiled the choleraic germs will be rendered innocuous. That the destruction of decaying organic matter in water is of the greatest importance there can be no doubt, for experience has proved that it also is productive of disease. It is, moreover, certain that organic matters of this description are rapidly oxidised by permanganate of potash and by filtration through animal charcoal and charcoal mixed with certain compounds of iron; but it is more than doubtful, even if it were practicable, whether such processes of purification should be used by the water companies at the sources of supply—seeing how many causes of pollution exist between those

sources and the consumer. Besides which, it must not be forgotten that only a very small part of the water delivered by the companies is used for primary domestic purposes—the great bulk of it being employed for flushing closets, drains, and sewers, for watering streets, and for various manufacturing operations. It would, therefore, manifestly be an unnecessarily wasteful application of a tedious and expensive process, to do that at the works, which can be so easily, so surely, and so much more economically done at the point of consumption. But, after all, the most important consideration at the present time is the means of obtaining a constant water supply, so that the prolific sources of contamination and of real danger to the community, the filthy butts and cisterns, may be entirely abolished. The very first step towards the attainment of this object must be made by the public themselves; for it is idle to expect a constant supply while there is the present imperfect condition of almost every household service. If, indeed, such a supply were at once given to us, it would assuredly fail, for all the water of the Welsh hills would be insufficient to maintain it. The daily supply of water to London is at the rate of about thirty gallons per head, whereas experience has proved in many instances that with a well-regulated constant service it need not exceed twenty gallons a head. As a matter of economy, therefore, as well as of public health, it is high time that the consumer should make preparation for such a supply in the way that the Act of Parliament directs, and then there would be no difficulty in applying processes of purification at every point where the water is used for domestic purposes. At the present juncture it is advisable that all water stored in butts or cisterns should be boiled before it is drunk, and where it is practicable, it should be previously filtered through animal charcoal, or charcoal associated with proper compounds of iron; and failing this, it may be treated with a little of Condy's solution of permanganate of potash until it retains a very pale but decided tint of rose red. In all cases, however, it should be boiled.

Rhœadine.—Hesse, looking for morphia, has discovered a new alkaloid in the red poppy; it is also to be found, he says, in good opium. It is soluble in water, alcohol, and ether, crystallising from the last in white prisms. Ammonia precipitates it in white crystalline flocculi, bichloride of mercury gives a white amorphous precipitate, chloride of gold a yellow precipitate. Strong acids decompose it in the cold, giving a purple solution. The author promises to publish his method of extracting *Rhœadine*.

Condy's Fluid and Carbolic Acid.—All London is now smelling of carbolic acid. Placards recommending disinfectants are affixed to every wall, and in the parish in which we live men are going round the houses of the poor with instructions to put a dose of carbolic acid into every sink and closet, and to put half an ounce of Condy's red fluid into every water receptacle that is made of wood. These measures are taken in the belief that something dangerous lurks in dirty drains which carbolic acid can destroy, and something in suspicious drinking water which Condy's fluid can destroy, leaving the water fit for use. So far as regards cholera, the dangerous matter may be of three kinds: either living matter of some low sort, as held by Dr. Beale, and rendered most highly probable by the Cattle Plague Reports; or an alkaloid, as held by Dr. Richardson; or, lastly, matter in a state of change, according to Liebig's theory, which last hypothesis is not inconsistent with the first. Let us suppose a water of a bad, or at least a suspicious marshy smell; the addition of one or more drops of "Condy," or of one of the finer solutions of permanganate, will speedily remove that smell and taste, and make the water fresher and nicer. The quicker the decoloration, the greater the need of it. If water so treated, with a slight pink colour remaining, be passed through a filter, it comes out perfectly clear and colourless; but without filtering may be used for cooking or making tea and coffee after the brown sediment has settled. Most assuredly any one thirsty enough to drink raw London water just now had better use the permanganate and filter too. It seems generally agreed that the gases of decomposition are very quickly neutralised by this means, and that organic matter actually decomposing very quickly decolorises the liquid also. But this is not the case with *stable* organic matter. Water coloured with Condy so as not to be drinkable with pleasure, yet may contain animalcules in the most lively state. Nay, the amœba, paramœcium, colpods, and other disgusting brooda are not in the least affected by water too reddened to be drinkable. The same with regard to minute plants. Give *quantity* enough and *time* enough, and all will be destroyed—first, the stinking gases; next, the decaying organic matter which evolves them; then the microscopic animalcules which feed on it, and which, if not destroyed by the Condy, would die of starvation; and the plants last. Time and quantity also are required for the destruction of such a substance as the bitter extract which is diffused into water from quassia; this may be got rid of in twelve hours. The resistence of strychnia is much greater; still a very weak solution may be deprived of all bitter taste by excess of permanganate in twenty-four hours. Matters having organic form and firmness, as starch, &c., if not decomposing, are very slowly acted on. Animalcules of the kinds indicated may also live in water just containing carbolic acid enough to be smelt and tasted. The conclusions we would draw from the above remarks are that when we employ the carbolic acid for the disinfection of drains, sinks, etc., it ought to be employed in a state of pretty high concentration and large quantity, so as, above all things, to purify the aperture out of which the dangerous emanations would come. Likewise in the use of Condy's fluid for purifying water-butts, enough should be used, but we should take care also that the butts themselves are cleansed, and pitched or charred inside, for it is a waste of force to use the permanganate to do what might be done by a handful of lighted shavings and a brimstone match. — *Medical Times and Gazette.*

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

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To Medical Officers of Health and Others.—The Editor will feel greatly obliged if Medical Officers of Health, and others in authority in any part of the kingdom, will forward to him, at the office of this paper, any printed papers or directions which they may have issued in their respective districts, having reference to the precautions recommended to be taken during the present prevalence of cholera.

Un Ami is requested to send his name and address.

E. O. F.—You had better apply at once to the medical officer for your district. The handle should be removed immediately; the water is dangerously impure.

F.C.S.—The practice is, to say the least, unprofessional and undignified, and we must express our regret that any Fellow of the Society should adopt it. As put before us in its present shape, however, the matter is not ripe for publication.

F. H.—We were not aware of the existence of the battery. The *rationale* is not difficult to understand. When the circuit is closed the copper dissolves in the sulphuric acid, whilst the hydrogen evolved at the carbon pole is instantly oxidised by the oxygen of the chromic acid it there meets. The objections appear to be (1) the necessity of a porous cell, and (2) the expense of consuming copper instead of zinc.

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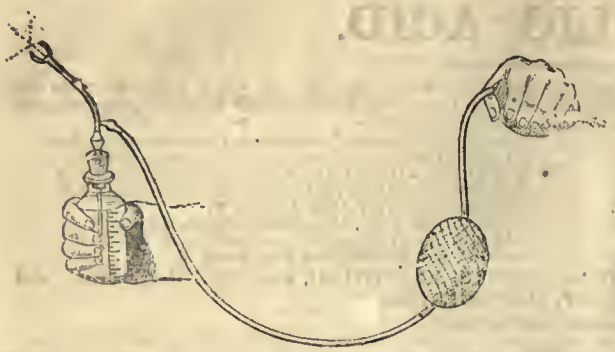

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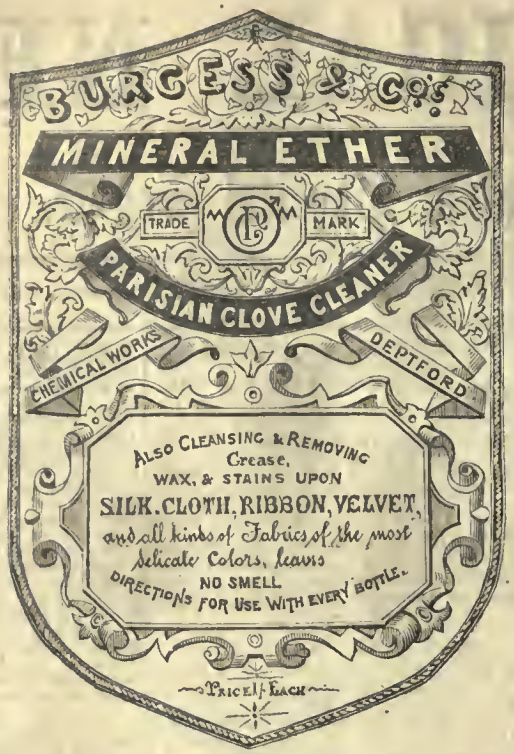

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Researches on the Volatile and Fixed Oil of the Fruit of Samphire (Crithmum maritimum), by M. HÉROUARD.

THE samphire is an umbelliferous plant growing abundantly on the rocky coasts of France and England. All parts of the plant are aromatic, and it is used as an ingredient in flavouring pickles, etc. The most favourable time for the extraction of the volatile oil is from September 10 to October 15, and the fruits yield 1·5 to 1·6 per cent. of the oil.

The oil of samphire is composed of a light and a heavy oil, the latter separating from the milky distilled water on standing, the former, which is the aromatic oil of the plant, floating on top. This is limpid and mobile when recent, has a sweet odour and hot aromatic taste. It boils at about 350° Fahr. Its specific gravity is 980° at 55° F. It is oxidised by the air, becomes thick and heavier than water; when recent it remains fluid at 49° Fahr., but the old oils deposit silky needles when cooled. Further investigation found this body to be a result of oxidation, and to be an acid, and the oil itself to yield, by the action of weak nitric acid, a hydruret of a compound radical parallel with benzyl, which the author calls "crithmyle," and which forms combinations with chlorine, bromine, and iodine. The acid by oxidation is crithmic acid.

Hydruret of crithmyle is an oily brown liquid of specific gravity 1·07, has an aromatic odour of the plant; its taste acrid and burning, effecting the throat strongly; it is insoluble in water, but readily soluble in alcohol and ether, and burns with a sooty flame.

Crithmic acid presents the form of colourless brilliant prismatic needles which resemble those of benzoic acid, a taste lightly acid, no odour, volatile without decomposition. Slightly soluble in cold water, more soluble in hot water, and readily in alcohol and ether and in the oil of samphire, from which it is derived.

The fixed oil of the fruit is siccative, of an orange yellow colour, and oxidises readily in the air to a brown soft solid.—*Jour. de Pharm.*, May, 1866, 324.

On a Process of Organic Elementary Analysis, by Combustion in a Stream of Oxygen Gas, by C. M. WARREN.

THE process in general use for ultimate organic analysis had seemed to me so nearly perfect as to leave little room for any very marked improvement. Like all other processes of analysis, however, it has its own peculiar sources of error, inherent in the nature of the substances employed, and in the manipulations to be performed. But these appear to have been reduced to a minimum; so that, with great care and the necessary skill, there can be no reason to doubt that that process, with the various modifications which have been proposed to meet special cases, is capable of affording as accurate results, in a majority of instances, as can, perhaps, be claimed for any other analytical process. Nevertheless, there are instances, and they are doubtless numerous, where so satisfactory a solution of the question which may be under consideration as would be highly desirable, cannot be attained by that process. It was after repeated unsuccessful efforts, in a case which appeared to be of this kind, that I was led to conceive the idea of making the combustion in oxygen gas alone, and to devise the method which I am about to describe.

Were it not for the danger of explosions in the combustion tube, the occurrence of which would, at least, render its use fruitless of good results, the employment of pure oxygen, as a combustion agent in analysis, would seem, of all substances, the one most naturally suggested. This apparent difficulty is probably the chief reason it has not long ago been brought into general use; its employment since the time of Prout, so far as I am informed, having been mostly confined to the combustion of the residual carbon of highly carbonaceous substances, after the other decomposition products, containing the hydrogen, had been burnt at the expense of oxide of copper.

By a very simple device I entirely obviate the danger of explosion—viz., the combustion tube is closely packed with asbestos, or other inert substance,* and yet so loosely as to leave free passage for gases through the interstices. The packing of the tube requires some care. This, however, may be readily accomplished, giving great uniformity to the mass of asbestos, by having the latter carefully broken into small loose pieces, which are gradually added to the tube, and arranged in position by means of a stiff iron wire. Little attention need be had to the packing of the centre of the tube, as this will come right of itself, if the packing against the sides is properly done. It will be found convenient and expeditious to turn the tube continuously in the hand, and cause the end of the iron rod to follow around against the sides of the tube, placing the asbestos, by gentle taps, alongside its inner surface, so that only very small open spaces may be seen.

In the experiments which I have made I have generally had about ten or twelve inches in length of the tube filled with asbestos. As the combustion takes place within a very short space, it seemed at first that the tube might be reduced considerably below the ordinary length; it was found, however, that shortening of the tube below a certain limit made it difficult to control the distillation of volatile substances and prevent too rapid combustion; it being essential in this, as in other processes, that the combustion should proceed slowly, and with a good degree of regularity; otherwise it would be difficult to regulate the supply of oxygen to meet the demand of the burning substance. By having the column of asbestos of considerable length, the anterior end of which only is ignited, the substance, if volatile, becomes diffused through a large space, and the distillation thereby easily controlled; as only a small portion of the substance need then be heated at a time. Doubtless a shorter tube would answer equally well for many non-volatile substances. It will be observed that the asbestos packing is but another application of the principle involved in the use of wire gauze in Davy's safety-lamp.†

In order to obtain perfect control of the analysis, and

* I have used only asbestos in my experiments thus far, and in every instance with perfect success. Quartz sand, selected with care as to the size of the grains, had suggested itself, on account of greater convenience in filling the tube, as it would properly arrange itself on simply being poured into the tube. It would, however, be liable to the objection, that any jarring of the tube, while lying upon the combustion furnace, would be likely to settle the particles more closely together and form a channel along the top, in which an explosion might take place which would spoil the analysis. I therefore prefer asbestos to anything which I have thought of; and any apparent inconvenience in preparing a tube with this substance will pass into insignificance, if the precautions which I advise for protecting the tube from breakage are observed, as then the same tube may be made to last for a long time.

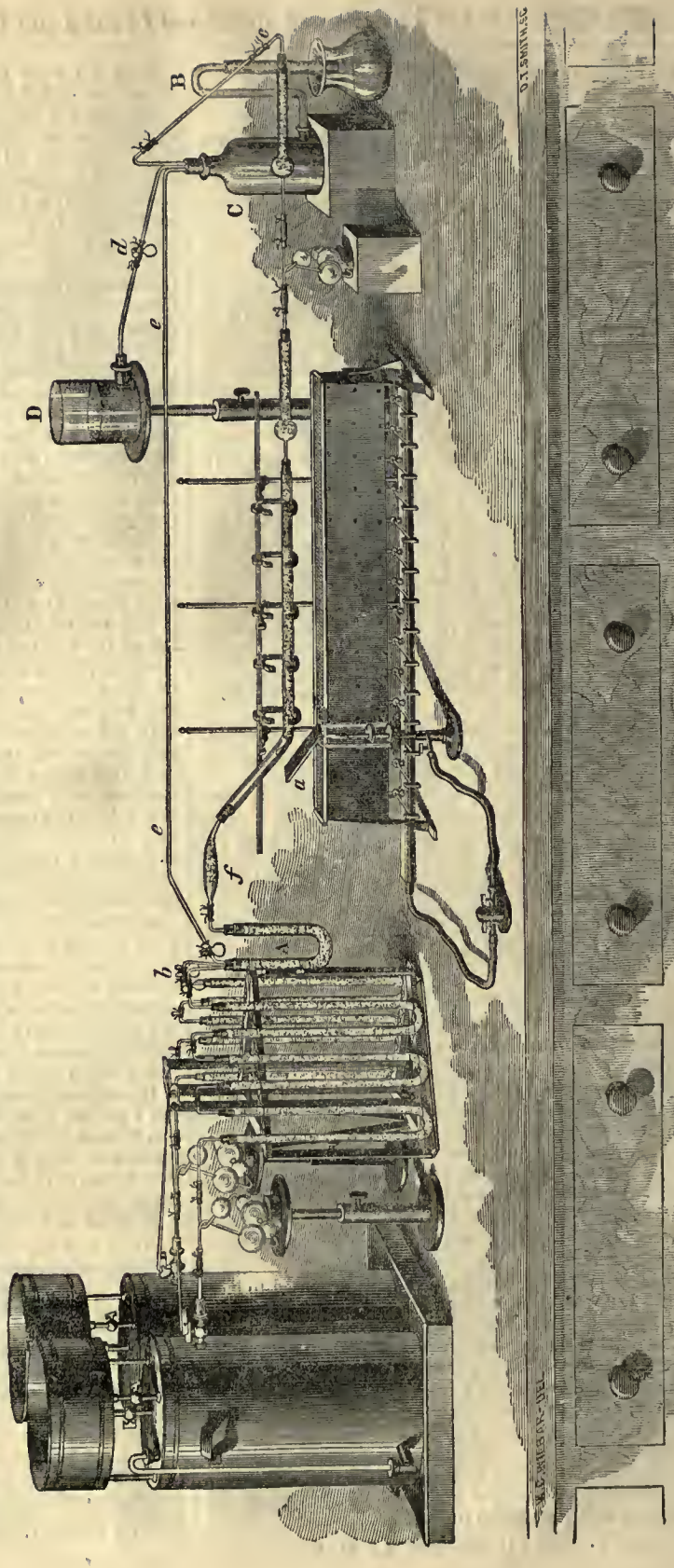
† It has occurred to me that my safety-tube may serve as the basis of a more simple and equally accurate process for the analysis of gases, by gradual combustion, instead of explosion, in which weighing would take the place of measurement. I propose, at an early day, to study this question by a series of experiments.

to be always certain that the requisite quantity of oxygen is being admitted, I have adopted certain simple expedients, enumerated below, which have been found fully adequate to that end.

1. The distillation of the substance, if volatile, is effected by means of a bar of copper placed over and attached to one of Bunsen's burners, as shown at *a* in the accompanying figure.

This bar, having first been brought to the maximum temperature which the lamp is capable of producing, is placed near or under the bulb containing the substance; applying that part of the bar nearest or most remote from the flame, or an intermediate point, according to the temperature required.

The steadiness of the heat thus applied, and the facility with which it may be regulated by simply moving the bar, render it decidedly preferable to any other means which I have employed for that purpose. I had for a long time used such a bar for the same purpose in the old process with extreme satisfaction. In some cases a bar of copper laid on the combustion furnace,‡ one end pro-



‡ As there are those, and probably there are many, who still persist in the use of charcoal in place of the more modern gas furnaces for generating heat for combustions, I desire here to say that I have in use one of Baumhauer's gas furnaces, procured a few years ago from Luhme and Co., in Berlin, which seems to me to have no fault. It is impossible for me to conceive what objection one could have to it, unless it be that a naked tube might become overheated along the bottom; and this would be a valid objection if the remedy were not so simple. If the tube be laid in a trough of sheet iron (brass is objectionable, in my process, on account of its obscuring the tube with oxide of zinc), with a thin layer of asbestos between, and fastened together with wire, no harm can ever occur from overheating. A tube of Bohemian glass, thus protected, may be used for a large number of analyses; and, indeed, become almost a permanent fixture upon the furnace. The asbestos prevents the glass and metal from adhering together — which is probably the chief or only cause of breakage of wrapped tubes—so that sudden cooling and reheating may take place with perfect security. It is important that the iron trough should not extend much backward of that part of the tube where it is desired that the combustion should take place, so that the temperature of the principal part of the column of asbestos may remain under the control of the operator, by means of the heated copper bar, or otherwise. Independent of the use of a metallic bar, as described above, or any novel appliance, the heat can be regulated by this furnace with as great or even greater nicety than by the use of coal. The partitions in this furnace between the cocks are two inches apart; so that the gas from one of the jets ignites about two inches of the tube. To rely, therefore, alone upon the cocks for regulating the heat in burning the substance would doubtless often lead to bad results; but the heat may be made to approach the substance in the most gradual manner—next to that of conduction by a metallic bar—by making use of a piece of thin brass plate, about two inches long, and half an inch wider than the top of the furnace, the edges of which are turned down against the sides. If this plate is laid on the wire gauze covering the furnace, and

jecting into the flame by which the tube is being heated, and the other end raised and extending towards the substance, has been found to answer a good purpose.

2. In the case of volatile bodies (I have not yet analysed any others by this process), I have found the combustion to proceed most satisfactorily when, having first heated about four or five inches of the anterior portion of the tube, which includes the oxide of copper, and started the flow of oxygen, I apply the heated bar to the bulb containing the substance, and immediately expel the whole of the liquid—which becomes at once absorbed by the asbestos—and then, if necessary, gradually move the heated bar forward, driving the substance towards the ignited portion of the tube, until it shall have reached that point in the tube where the temperature is just sufficient to cause the oxygen to take up the vapour in suitable proportion; indicated by the bubbles of oxygen and carbonic acid, as will be described below—a point as easily found as to find, in the old process, the requisite temperature for proper distillation of the substance. When this is accomplished, which will occupy but a short time, the heat in front of and behind the substance being constant and uniform, no further manipulation of the heat is required, the supply of oxygen only requiring attention. In the ordinary way, on the contrary, in which the heat is applied only on one side of the substance, the latter, if volatile, is constantly changing position backward in the tube, necessitating a corresponding movement of the heat in the same direction; which requires constant care and considerable skill.

This procedure—referring to the immediate expulsion of liquid from the bulb, etc.—implies that that portion of the tube immediately forward of the bulb should not already be too warm, which might easily be the case with a body of very low boiling-point. It would then be necessary to expel the substance from the bulb no faster than the oxygen would absorb it in the proper proportion; which, as experience has shown, may be easily accomplished.

With a body of extreme volatility it may be also necessary to place a dish containing pieces of ice under the bulb; as even the temperature of the surrounding air might in such a case cause the substance to pass forward too rapidly.

3. The oxygen is admitted through Liebig's potash bulbs containing sulphuric acid; and the carbonic acid formed is absorbed by similar bulbs with potash; to which is attached a tube filled with soda-lime and chloride of calcium, as recommended by Mulder,§ to take up any traces of carbonic acid which may escape absorption in the bulbs, and the trace of moisture which is invariably carried forward from the latter. Special care should be taken to select both sets of bulbs with the view to have the openings in the one as nearly as may be of the same size as those of the other, so that the bubbles of oxygen, considered as representing volumes, entering the sulphuric acid bulbs, may be readily compared with the bubbles or volumes of carbonic acid entering the potash bulbs; these bubbles may then serve as a valuable index by which to regulate the supply of oxygen. Especially is this true in cases where the composition of the body to be analysed is pretty nearly known, as then the number of bubbles of oxygen required for every bubble of carbonic acid produced may be readily calculated.

But as it is, in any case, advisable to conduct the experiment so that there shall always be an excess of oxygen passing unabsorbed through the potash bulbs, and as this excess would seldom be large even if a sufficiency of oxygen were admitted to burn the most richly hydrogenised body known, it may generally be well to admit enough for such a case.

The volume of oxygen actually consumed in burning the lightest liquid known—probably of the formula C_5H_{10}—which I have separated from petroleum, and which contains a larger percentage of hydrogen than any other non-gaseous body, as compared with the volume of carbonic acid formed, is 1·62 : 1; the fraction representing the oxygen which is taken up by the hydrogen of the body, and which of course becomes condensed and disappears from the volume of carbonic acid. In burning this body with just the equivalent quantity of oxygen—assuming that the combustion would be complete under such circumstances—we should have one bubble or volume of carbonic acid entering the potash bulbs for every 1·62 bubbles or volumes of oxygen entering the sulphuric acid bulbs. A sufficient excess of oxygen would be secured in this case, and a simple ratio obtained, if 2 bubbles of oxygen were to be admitted for 1 bubble of carbonic acid appearing in the potash bulbs. The case would then be further simplified by having the openings in the sulphuric acid bulbs of such size as would give bubbles twice as large as those from the potash bulbs; as then, when the bubbling should be equally rapid in both, the relation between the volumes of the gases would still be maintained—viz., 2 vols. of oxygen to 1 vol. of carbonic acid. Such bulbs would be highly desirable, but would probably have to be made expressly for the purpose.

(To be continued.)

pressed down so as to fit closely enough to prevent the gas from igniting under it, the gas escaping from the cock underneath may all be made to burn at one end of the plate, and to extend the heat along the tube as gradually as the plate itself is capable of being moved.

§ Liebig and Kopp's *Jahresbericht*, 1858, p. 588.

New Researches on the Law of Chemical Proportions and on Atomic Weights and their Mutual Relations by J. S. Stas.*

(*Continued from page* 76.)

But if on my own part I submit to a rigid examination the basis on which the hypothesis of Prout rests, and the probability of its correctness, I arrive at doubts other than those a strictly scientific method raises with regard to the fundamental laws of chemical combinations. M. Marignac reminds us that the idea Prout had in his mind, and which led him to enunciate his theory, was that of the unity of matter. Prout regarded hydrogen as the unit. I have already said that Dr. Penny, of Glasgow, and M. Marignac have both proved that it is at least one-half too great so far as chlorine is concerned. M. Marignac and M. Dumas have shown the same fact as regards barium; their researches have further shown that it is four times too great for strontium; and lastly, I believe I have demonstrated that it is eight times too great for potassium, and at least sixteen times too great for nitrogen.

I know that an error in the choice of the unit by Prout does not necessarily overthrow his hypothesis; for, as M. Marignac has observed, Prout's idea is independent of the size of the unit. In fact, the hypothesis remains whether applied to existing bodies, known or not, or even to primordial matter no longer in existence. And admitting these conclusions as well founded, I am naturally led, upon principle, to examine the right of

* *Memoirs of the Royal Academy of Belgium.*

chemists who rely upon experiment to consider the hypothesis as the expression of a probable natural law.

When we go back to the origin of the theory, we immediately see that it owes its conception to a prejudice, or, if you will, a preconceived opinion, regarding *the simplicity of the laws of nature*. For a long time chemists, like physicists, from the moment they saw certain facts reproduced with apparent regularity, believed in the existence of a natural law capable of being expressed by a simple mathematical relation. They further contracted a habit of considering the law as demonstrated as soon as they had executed weighings or measurings which did not come very wide of it. The confidence in the prejudice was such that they invariably attributed the differences either to the method of observation or to unavoidable error in the experiment. This tendency in the mind, and I willingly say the greatest minds, has led men to consider as rigidly demonstrated mathematical laws the law of Boyle or of Mariotte, the law of Gay-Lussac concerning the expansion of gases by heat, and the law of Dulong and Petit regarding the specific heats of bodies; we know, however, to-day, beyond doubt, that these are limited laws, if, indeed, even so much can be said for the relation established by Dulong and Petit between specific heats and atomic weights.

It is to this very natural tendency that we owe the hypothesis of Prout. I think it would be very easy to prove that the English chemist was contented with the *very nearly*, authorised, perhaps, by his time, to conclude that the facts were reconcilable with his opinion. . I willingly render homage to the great aim of Prout; but to-day we have the right and even the duty to be more exacting with the partisans of his hypothesis. Although this article is intended as a reply to the objections of M. Marignac, I shall not further examine whether his admirable labours justify us in accepting the probability of the accuracy of Prout's law. It would be bad taste to do so, since M. Marignac no more believes than I do that experiment can be reconciled with the hypothesis.

There only remain for examination, then, the researches published by M. Dumas, upon which, indeed, all the partisans of the hypothesis of the unity of matter base their belief that it expresses a natural law. I proceed to the examination with a reservation that every chemist, I hope, will appreciate if the results contained in the memoir of M. Dumas "*On the Equivalents of Simple Bodies*" prove the law or render it probable.

With one or two exceptions, all the determinations to be found in that work are based on the atomic weights of silver and chlorine, represented respectively by 108 and 35·5. Neither of these two values was fixed experimentally by M. Dumas. He deduced them from the results of M. Marignac, who, bringing together silver and chlorine directly by the synthesis of the chloride and the analysis of chlorate of silver, and indirectly by the chloride and chlorate of potassium, arrived at from 107·91 to 107·92 for the atomic weight of silver and 35·455 for the atomic weight of chlorine. In truth, my illustrious teacher sought to discover whether the composition of chloride of silver can be represented by the proportion of 108 to 35·5, and he found that it might be; but even admitting this fact (which is, however, open to dispute), does it follow that the atomic weights of silver and chlorine are respectively 108 and 35·5? Clearly not, for all the atomic weights of these bodies, which are in exactly the same proportion to each other, agree with the composition.

In order that the consequences drawn from the proportion of 108 to 35·5 may be legitimate, it was necessary to have demonstrated *a priori* that these figures represent the real atomic weights of silver and chlorine. But neither the works of M. Marignac, nor those of other chemists published since, allow us to consider the fact as proved. Indeed, the determinations that merit the most confidence do not even render it probable.

When M. Marignac effected the synthesis of the chloride and the analysis of the chlorate of silver, in order to deduce from these two data the atomic weights of their elements functioning as oxygen, he remarked a cause of error in the analysis of the chlorate, the effect of which is rather to augment than diminish the atomic weight. I have remarked the same cause of error, as I shall describe further on. The result is exactly the opposite of that the cause of error ought to produce; instead of leading to a number higher than 108, it gives 107·91. Thus, the labours of M. Marignac, interpreted in the sense of his own observations, do not authorise us to believe it to be demonstrated, or even made probable, that the atomic weight of silver is 108 and that of chlorine 35·5. But I will suppose for a moment that I am mistaken; the basis on which M. Dumas has founded his determinations being admitted, do his researches prove that the atomic weights of the bodies on which he operated are really multiples by 1·00 or 0·50 or 0·25? I do not think it. In fact, whatever may have been his acuteness in discovering and avoiding causes of error, the quantities of matter he employed were in no case sufficiently great for the results obtained to contain in themselves the elements of a demonstration. My opinion on this point, after mature reflection, has never varied. When we wish to demonstrate that the atomic weights are multiples by 1·00 or 0·50 or 0·25, it seems to me evident that in the results the decimals of each of the factors should be constant. To make my meaning more evident, I will say before we can consider it as proved that certain atomic weights are multiples of 0·25, it is necessary that in the experiment the second decimal of the value of the atomic weight should remain constant; otherwise we infer the law of the hypothesis, and not of the experiment. But on examining the determinations made by M. Dumas from this point of view, we remain convinced that, however admirable for their precision, they do not satisfy us on this point. In my opinion they never could; for, supposing the matters operated upon to be absolutely pure, how can we reconcile the natural fact or the law, and the error of observation, when this error is as great in the majority of cases as the difference it is required to establish?

We cannot, then, found upon these determinations a belief in the hypothesis of Prout as the expression of a probable natural law, and still less as a demonstrated law, for the bodies to which the determinations apply.

(To be continued.)

On the Absorption and Dialytic Separation of Gases by Colloid Septa, by Thomas Graham, *F.R.S.*

It appears that a thin film of caoutchouc, such as is furnished by varnished silk or the transparent little balloons of india-rubber, has no porosity, and is really impervious to air as gas. But the same film is capable of liquefying the individual gases of which air is composed, while oxygen and nitrogen in the liquid form are capable of penetrating the substance of the membrane (as ether or naphtha does), and may again evaporate into a vacuum and appear as gases. This penetrating power of air becomes more interesting from the fact that the gases

are unequally absorbed and condensed by rubber, oxygen 2½ times more abundantly than nitrogen, and that they penetrate the rubber in the same proportion. Hence the rubber film may be used as a dialytic sieve for atmospheric air, and allows very constantly 41·6 per cent. of oxygen to pass through, instead of the 21 per cent. usually present in air. The septum keeps back, in fact, one half of the nitrogen, and allows the other half to pass through with all the oxygen. This dialysed air rekindles wood burning without flame, and is, in fact, exactly intermediate between air and pure oxygen gas in relation to combustion.

One side of the rubber film must be freely exposed to the atmosphere, and the other side be under the influence of a vacuum at the same time. The vacuum may be established within a bag of varnished silk or in a little balloon, the sides being prevented from collapsing by interposing a thickness of felted carpeting between the sides of the varnished cloth, and by filling the balloon with sifted sawdust. For commanding a vacuum in such experiments, the air exhauster of Dr. Hermann Sprengel* is admirably adapted. It possesses the advantage that the gas drawn from the vacuum can also be delivered by the instrument into a gas receiver placed over water or mercury. The "fall tube" has merely to be bent at the lower end.

The surprising penetration of platinum and iron tubes by hydrogen gas, discovered by MM. H. Sainte-Claire Deville and Troost, appears to be connected with a power resident in the same and certain other metals to liquefy and absorb hydrogen, possibly in its character as a metallic vapour. Platinum in the form of wire or plate at a low red heat may take up and hold 3·8 volumes of hydrogen, measured cold; but it is by palladium that the property in question appears to be possessed in the highest degree. Palladium foil from the hammered metal, condensed so much as 643 times its volume of hydrogen, at a temperature under 100° C. The same metal had not the slightest absorbent power for either oxygen or nitrogen. The capacity of fused palladium (as also of fused platinum) is considerably reduced; but foil of fused palladium, for which I am indebted to Mr. G. Matthey, still absorbed 68 volumes of gas. A certain degree of porosity may be admitted to exist in these metals, and to the greatest extent in their hammered condition. It is believed that such metallic pores, and indeed all fine pores, are more accessible to liquids than to gases, and in particular to liquid hydrogen. Hence a peculiar dialytic action may reside in certain metallic septa, like a plate of platinum, enabling them to separate hydrogen from other gases.

In the form of sponge, platinum absorbed 1·48 times its volume of hydrogen and palladium 90 volumes. The former of these metals, in the peculiar condition of platinum black, is already known to take up several hundred volumes of the same gas. The assumed liquefaction of hydrogen in such circumstances appears to be the primary condition of its oxidation at a low temperature. A repellent property possessed by gaseous molecules appears to resist chemical combination as well as to establish a limit to their power to enter the minuter pores of solid bodies.

Carbonic oxide is taken up more largely than hydrogen by soft iron. Such an occlusion of carbonic oxide by iron at a low red heat appears to be the first and a necessary step in the process of acieration. The gas appears to abandon half its carbon to the iron, when the temperature is afterwards raised to a considerably higher degree.

Silver has a similar relation to oxygen, of which metal the sponge, fritted but not fused, was found to hold in one case so much as 7·49 volumes of oxygen. A plate or wire of the fused metal retains the same property, but much reduced in intensity, as with plates of fused platinum and palladium in their relation to hydrogen.—*Proceedings of the Royal Society.*

* Chemical Society's *Journal*, ser. 2, vol. iii., p. 9 (1865).

TECHNICAL CHEMISTRY.

The Manufacture and Properties of Aniline Colours, and the Bodies used in their Preparation, by MM.* Depoully *Brothers.*

(Continued from page 77.)

II. Nitrobenzols. — Practice has rendered easy the manufacture of nitrobenzol, which at first was dangerous. The precautions by which all chance of accident is avoided are precisely those which are necessary for obtaining good results. As of the first importance must be ranked the purity of the benzols, perfect washing, and careful fractional distillation.

Phenols render the attack by acids dangerous, and give offensive nitrogenised products. Naphthaline gives nitronaphthalines, which destroy the beauty of the nitrobenzol, and afterwards, at the transformation into aniline, produce alkaloids which become resinous in the air, and still more during the manufacture of colouring matters. In short, the hydrocarbides above toluol are partially oxidised by too strong acid mixtures, and the portion transformed into nitrogenised bodies gives alkaloids distilling above 200°, and which have hitherto been of little use, either as regards the quantity of the matter obtained or the beauty of its colour.

The use of pure benzols dispenses with an expensive and dangerous operation, involving considerable loss of material—namely, the distillation of nitrobenzol.

Another precaution, essential for avoiding a conflagration, is never to place in contact a large mass of acid and of unattacked hydrocarbides. Take, for instance, a mixture of benzol and toluol.

Various processes are still in use for their transformation into commercial nitrobenzol.

All rest on the same principle; never put a fresh quantity of benzol in contact with acid until the preceding portion is almost entirely transformed into nitrobenzol. Accidents are thus avoided, and also too great heat, which would give secondary products in presence of an excess of acid.

Fuming nitric acid almost instantaneously transforms benzol into nitrobenzol. By causing benzol to fall slowly into a vessel containing fuming nitric acid, placed in cold water, and leaving the mixture for twenty-four hours, the transformation will be complete provided the quantity of acid be sufficient.

There are various inconveniences in this method. In the first place the strength, and consequently the action, of the acid are constantly decreasing; then a portion of the oil remains untransformed at the close of the operation, unless there be a large excess of acid, which is out of the question at the present prices. Moreover, nitrobenzol may change to solid binitrobenzol, in presence of this mass of strong acid, while toluol may oxidise or give binitrotoluol.

* Memoir presented to the *Société Industrielle de Mulhouse* at the meeting of May 31, 1865.

An earthenware worm has been much used, placed in a basin full of water. Into the upper part of the worm we caused a fine stream of fuming acid and one of benzol to flow regularly; these two currents mingled, and the reaction was almost finished by the time the mixture arrived at the lower part; small basins or depressions arranged along the line of the worm were found to favour the action.

The flowing being so regulated that one equivalent of benzol flows at the same time as one equivalent plus a small excess of acid, the reaction took place under favourable conditions, and the yield was large, and the quality of the product good.

One advantage of fuming nitric acid is that the nitrobenzol and acid remain dissolved, one in the other, forming but one liquid, which helps to complete the reaction. But the necessary apparatus is costly and fragile; and, above all, fuming nitric acid is dangerous to handle.

Many manufacturers use a mixture of nitric and sulphuric acid at 66° (1·847), varying in its proportions according to the strength of the nitric acid. The quantity of sulphuric acid must always be sufficient to bring the nitric acid to 1 or 2 equivalents of water; th nitric acids used must be rather above than below 40° (1·38).

The benzol may be added gradually to the acid mixture, a small quantity each day, care being taken to stir it often; for here the products form two layers, and the stirring is necessary to bring all the matters in contact. Two or three weeks are frequently required to effect a complete transformation; and there must be a sufficient excess of acid.

However, this method on a large scale gives satisfactory results, both as regards quality and quantity.

In England, and lately in France, this process has been modified by performing the operation in closed apparatus, of the kind also used in England in the manufacture of aniline.

The benzol and the acid mixture arrive in two regulated streams, a mechanical stirrer unceasingly places the matters in perfect contact, the heat of the reaction is allowed to act partially, and highly concentrated nitric acids are used. The reaction is very rapidly effected, and the amount of acid required is about the theoretical quantity. A worm receives the benzol which escapes during the reaction.

Whatever may be the method employed when the reaction is at an end—which is easily ascertained by the decoloration of the products—the acid remaining must be diluted with water to arrive at the complete separation of the nitrobenzol; but the degree of concentration may be low enough to admit of the acids being utilised for certain purposes; thus, the concentration of the sulphuric acid, more or less charged with nitric acid, may be kept at 50° to 55° (1·53 to 1·61).

The nitrobenzol and diluted acid form two layers, which may be separated by decantation. The nitrobenzol must then be washed with water, then with very weak carbonate of soda, and then again with water.

Great care is needed in the washing, as here the greatest losses are to be feared, and moreover inefficiently washed nitrobenzols, retaining acids and nitrous vapours, produce impure anilines; the nitrous vapours react on the portion of the aniline formed and give tarry products.

A method of washing, which we have found very successful, consists in neutralising the decanted nitrobenzols by a slight excess of ammonia, when sulphates, nitrates, and nitrites of ammonia are formed. By heating to 105° or 110° centigrade, the nitrite is decomposed into nitrogen and water vapour, and the nitrates and sulphates remain insoluble; it is then only necessary to filter. In this way nitrobenzols are obtained in a very favourable state for the manufacture of aniline.

The yields of aniline now obtained in wholesale manufacture are considerable, varying from 130 to 135 per cent. of the weight of benzol, about 10 per cent. below the theoretical quantity for a mixture of one part of benzol and two of toluol.

It is probable that both the yield and the purity of the products might be improved by operating separately on the benzol and toluol; for they are not equally sensitive to the action of nitric and sulphuric acids. Nitric acid attacks toluol much more quickly than benzol. In proof of this we will mention the presence, in acids which have served in the fabrication of commercial nitrobenzols, of nitrodracylic acid, isomeric with nitrobenzoic acid $C_{14}H_5(NO_4)O_4$, evidently derived from the oxidation of nitrotoluol $C_{14}H_7(NO_4)$, and not of nitrobenzol $C_{12}H_5(NO_4)$.

Moreover, toluol is acted on by sulphuric acid at 66 degrees, even unassisted by heat; while benzol is not attacked. It would then be advisable to act on each of these substances separately, by acid mixtures suited to their nature.

To test a commercial nitrobenzol, before transforming it into aniline, first ascertain its density, which will be so much higher, as it contains more nitrobenzol and less nitrotoluol. The density of nitrobenzol at 15° C. is 1·209, that of nitrotoluol 1·180. But should the nitrobenzol contain unattacked hydrocarbides, or binitrogenised bodies, the density would be less low or too high; recourse must then be had to distillation. Nitrobenzol distils at 213°, nitrotoluol at 225°, of which all that passes before 213° must be rejected. A good nitrobenzol, to make good aniline red and violet, should distil between 215° and 230°, the greater part between 220° and 227°; this will contain the two bodies in the proportions best adapted to the production of a good aniline. No more than traces of nitrous or acid vapours should be produced during the distillation.

(To be continued.)

PHYSICAL SCIENCE.

On the Connexion between the Physical Properties of Chemical Bodies and their Atomic Composition, by T. A. GROSHANS.

THE problem "Are all the so-called chemical elements really simple bodies?" does not appear to me to be one of those of which we have no hope to find the solution; and perhaps that solution will be found much sooner than is expected.

I published in the *Archives des Sciences Physiques et Naturelles*, Genève, Mai 1863, a paper, containing a list of twenty-five bodies, which agree in this most important particular:—

That their vapour-densities (taken at 0·76 m. and the respective temperatures of ebullition) are nearly in the same ratio as the numbers of atoms of carbon, hydrogen, and oxygen, which these bodies contain.

I give here this list or table, which I have modified as to the adoption of the atomic weights (H = 1, C = 12, O = 16) and the methods of notation which are at present in general use.

No.	Names.	Chemical Formulæ.	Atomic Weights.	Mean Boiling Points.	Calculated Vapour Densities, d.	Numbers of Atoms of C, H, & O.
1.	Water.	H_2O	18	100	3	3
2.	Ethylic gas	C_4H_{10}	58	—14	13·9	14
3.	Ether	$C_4H_{10}O$	74	35·2	14·9	15
4.	Oxide of ethyl-allyl	$C_5H_{10}O$	86	64·0	15·9	16
5.	Propionic ether	$C_5H_{10}O_2$	102	96·8	17·1	17
6.	Carbonic ether	$C_5H_{10}O_3$	118	125·5	18·4	18
7.	Allyl	C_6H_{10}	82	59·0	15·3	16
8.	Oxide of allyl (metaceton)	$C_6H_{10}O$	98	84·2	17·0	17
9.	Anhydrous propionic acid	$C_6H_{10}O_3$	130	165·0	18·4	19
10.	Oxalic ether	$C_6H_{10}O_4$	146	184·6	19·8	20
11.	Anhydrous lactic acid.	$C_6H_{10}O_5$	162	200·0	21·3	21
12.	Allylic alcohol	C_3H_8O	58	93·0	9·8	10
13.	Propionic acid (hydrate).	$C_3H_8O_2$	74	141·2	11·1	11
14.	Oxalic allyl-oxide	$C_8H_{10}O_4$	170	206·5	22·0	22
15.	Butyl-aldehyd	C_4H_8O	72	70·5	13·0	13
16.	Acro-aldehyd	$C_4H_8O_2$	88	110·0	14·3	14
17.	Toluol	C_7H_8	92	109·2	14·9	15
18.	Anisol	C_7H_8O	108	150·0	15·8	16
19.	Pyromucic ether	$C_7H_8O_3$	140	209·0	18·0	18
20.	Phenol	C_6H_8O	94	186·8	12·6	13
21.	Benzoic acid	$C_7H_8O_2$	122	250·0	14·5	15
22.	Cinnamen	C_8H_8	104	146·0	15·4	16
23.	Benzoic methyl-ether	$C_8H_8O_2$	136	198·8	17·9	18
24.	Salicylic methyl-ether	$C_8H_8O_3$	152	222·0	19·1	19
25.	Methylic alcohol	CH_4O	32	64·0	5·9	6

This table is constructed upon the well-known principle that when of two bodies, A and B, we call—

	Of A.	Of B.
The atomic weights	a	a'
The points of ebullition	s	s'
The vapour-densities at 0·76 m. and s, s'	d	d'

we have the following equation:—

$$\frac{d}{d'} = \frac{a}{a'} \times \frac{273+s'}{273+s}$$

Now, when we take for the body B water H_2O, we have:—

$$\frac{273+s'}{a'} = 273 + 100 = 373$$

$$d' = \begin{array}{l} 2\,H \\ 1\,O \\ \hline 3 \end{array} \qquad \begin{array}{l} = 18 \\ \\ \\ = 3 \end{array}$$

and the equation becomes:—

$$d = \frac{a}{18} \times \frac{373}{273+s} \times 3$$

By this last equation all the vapour-densities d of the preceding table have been calculated.

As for the points of ebullition mentioned in the table, I have used generally all the observations which were published in 1863. The following may be taken as a specimen of the method used:—

5, Propionic ether, $C_5H_{10}O_2$.

The following observations refer not only to this ether, but also to its isomers, as butylic methyloxide, acetic propyloxide, &c.

Delffs	93°0	Berthelot	90°0
Favre and Silbermann	93·0	Pelouze and Giles	102·0
H. Kopp	95·0	T. Pierre	102·1
„	95·1	Wurtz	100·0
„	96·9	Limpricht and Uslar	101·0

Mean (used in the table), 96·8°.

From the results contained in the table I have drawn several consequences, which have been subsequently found true by later observations:—

1. As a great many bodies, consisting of C, H, and O, could not be placed in the table, it was probable that they could be assembled in analogous tables, in which the bodies were not compared to water, but to some other body, as, for example, ethylic alcohol, propylic alcohol, etc. I have been able to construct many tables in this manner.

2. All bodies consisting of C, H, and O, may be placed in one or the other of such tables.

3. Different tables are connected with each other by some constant numbers; these numbers I have been able to calculate.

4. It may be then expressed as a general fact:—The vapour-densities (at the same pressure and at corresponding temperatures) of bodies consisting of C, H, and O, are in the same ratio as the numbers of atoms which these bodies contain, provided that they belong to the same group.

We have here an analogous phenomenon to that of the specific heats, which (being multiplied by the atomic weights) are also the same for bodies belonging to the same group.

5. As for other elements than C, H, and O, a way is opened by which we can determine the exact number of atoms which they contain. I have hitherto found that sulphur (S = 32) contains two atoms, and chlorine (Cl = 35·5) four atoms.*

Rotterdam, August 9.

PROCEEDINGS OF SOCIETIES.

BRITISH ASSOCIATION, NOTTINGHAM.

Address of WILLIAM ROBERT GROVE, *Esq., Q.C., M.A., F.R.S., President.*

[THE Address of the President is too long for insertion *in extenso*, so we follow our usual custom of giving a series of extracts relating to those sciences with which the CHEMICAL NEWS is specially occupied.]

In a series of papers recently communicated to the French Academy, M. Daubrée has discussed the chemical and mineralogical character of meteorites as compared with the rocks of the earth. He finds that the similarity of terrestrial rocks to meteorites increases as we penetrate deeper into the earth's crust, and that some of the deep-seated minerals have a composition and characteristics almost identical with meteorites (olivine, herzolite, and serpentine, for instance, closely resemble them); that as we approach the surface rocks having similar components with meteorites are found, but in a state of oxidation, which necessarily much modifies their mineral character, and which, by involving secondary oxygenised compounds, must also change their chemical constitution. By experiments he has succeeded in forming from terrestrial rocks substances very much resembling meteorites. Thus close relationship, though by no means identity, is established between this earth and those wanderers from remote regions—some evidence, though at present incomplete, of a common origin.

Surprise has often been expressed that, while the mean specific gravity of this globe is from five to six times that of water, the mean specific gravity of its crust is barely half as great. It has long seemed to me that there is no ground for wonder here. The exterior of our planet is to a considerable depth oxidated; the interior is in all pro-

* Should the formerly used atomic weights (C=6, H=1, O=8) be the true ones, then chlorine consists of 8 atoms.

bability free from oxygen, and whatever bodies exist there are in a reduced or deoxidated state; if so, their specific gravity must necessarily be higher than that of their oxides or chlorides, &c. We find, moreover, that some of the deep-seated minerals have a higher specific gravity than the average of those on the surface; olivine, for instance, has a specific gravity of 3·3. There is, therefore, no *d priori* improbability that the mean specific gravity of the earth should notably exceed that of its surface; and if we go further, and suppose the interior of the earth to be formed of the same ingredients as the exterior, minus oxygen, chlorine, bromine, &c., a specific gravity of 5 to 6 would not be an unlikely one. Many of the elementary bodies entering largely into the formation of the earth's crust are as light or lighter than water—for instance, potassium, sodium, &c.; others, such as sulphur, silicon, aluminium, have from two to three times its specific gravity; others again, as iron, copper, zinc, tin, seven to nine times; while others, lead, gold, platinum, &c., are much more dense, but, speaking generally, the more dense are the least numerous. There seems no improbability in a mixture of such substances producing a mean specific gravity of from 5 to 6, although it by no means follows; indeed, the probability is rather the other way, that the proportions of the substances in the interior of the earth are the same as on the exterior. It might be worth the labour to ascertain the mean specific gravity of all the known minerals on the earth's surface, averaging them in the ratios in which, as far as our knowledge goes, they quantitatively exist, and assuming them to exist without the oxygen, chlorine, &c., with which they are, with some rare exceptions, invariably combined on the surface of the earth. Great assistance to the knowledge of the probable constitution of the earth might be derived from such an investigation.

While chemistry, analytic and synthetic, thus aids us in ascertaining the relationship of our planet to meteorites, its relation in composition to other planets, to the sun, and to more distant suns and systems, is aided by another science—viz., optics.

But the most remarkable achievement by spectrum analysis is the record of observations on a temporary star which has shone forth this year in the constellation of the northern crown about a degree S.E. of the star ϵ. When it was first seen (May 12) it was nearly equal in brilliancy to a star of the second magnitude; when observed by Mr. Huggins and Dr. Miller, May 16, it was reduced to the third or fourth magnitude. Examined by these observers with the spectroscope, it gave a spectrum which they state was unlike that of any celestial body they had examined.

The light was compound, and had emanated from two different sources. One spectrum was analogous to that of the sun—viz. formed by the light of an incandescent solid or liquid photosphere which had suffered absorption by the vapours of an envelope cooler than itself. The second spectrum consisted of a few bright lines, which indicated that the light by which it was formed was emitted by matter in the state of luminous gas. They consider that, from the position of two of the bright lines, the gas must be probably hydrogen, and from their brilliancy, compared with the light of the photosphere, the gas must have been at a very high temperature. They imagine the phenomena to result from the burning of hydrogen with some other element, and that from the resulting temperature the photosphere is heated to incandescence.

It would seem as if the phenomenon of gradual change obtained towards the remotest objects with which we are at present acquainted, and that the further we penetrate into space the more unlike to those we are acquainted with become the objects of our examination—sun, planets, meteorites, earth, similarly, though not identically, constituted, stars differing from each other and from our system, and nebulæ more remote in space and differing more in their characters and constitution.

While we thus can to some extent investigate the physical constitution of the most remote visible substances, may we not hope that some further insight as to the constitution of the nearest—viz. our own satellite—may be given us by this class of researches? The question whether the moon possesses any atmosphere may still be regarded as unsolved. If there be any, it must be exceedingly small in quantity and highly attenuated. Calculations, made from occultation of stars, on the apparent differences of the semidiameter of the bright and dark moon, give an amount of difference which might indicate a minute atmosphere, but which Mr. Airy attributes to irradiation.

Supposing the moon to be constituted of similar materials to the earth, it must be, to say the least, doubtful whether there is oxygen enough to oxidate the metals of which she is composed; and, if not, the surface which we see must be metallic, or nearly so. The appearance of her craters is not unlike that seen on the surface of some metals, such as bismuth, or, according to Professor Phillips, silver, when cooling from fusion and just previous to solidifying; and it might be a fair subject of inquiry whether, if there be any coating of oxide on the surface, it may not be so thin as not to disguise the form of the congealed metallic masses, as they may have set in cooling from igneous fusion. M. Chacornac's recent observations lead him to suppose that many of the lunar craters were the result of a single explosion, which raised the surface as a bubble and deposited its *débris* around the orifice of eruption.

It would be out of place here, and treating of matters too familiar to the bulk of my audience, to trace how, by the labours of Oersted, Seebeck, Faraday, Talbot, Daguerre, and others, the way has been prepared for the generalisation now known as the correlation of forces or conservation of energy, while Davy, Rumford, Seguin, Mayer, Joule, Helmholtz, Thomson, and others (among whom I would not name myself, were it not that I may be misunderstood and supposed to have abandoned all claim to a share in the initiation of this, as I believe, important generalisation) have carried on the work; and how, sometimes by independent and, as is commonly the case, nearly simultaneous deductions, sometimes by progressive and accumulated discoveries, the doctrine of the reciprocal interaction, of the quantitative relation, and of the necessary dependence of all the forces, has, I think I may venture to say, been established.

If magnetism be, as it is proved to be, connected with the other forces or affections of matter, if electrical currents always produce, as they are proved to do, lines of magnetic force at right angles to their lines of action, magnetism must be cosmical, for where there is heat and light there is electricity and consequently magnetism. Magnetism, then, must be cosmical, and not merely terrestrial. Could we trace magnetism in other planets and suns as a force manifested in axial or meridional lines—*i.e.*, in lines cutting at right angles the curves formed by their rotation round an axis, it would be a great step; but it is one hitherto unaccomplished. The apparent coincidences between the maxima and minima of solar spots, and the decennial or undecennial periods of terrestrial magnetic intensity, though only empirical at present, might tend to lead us to a knowledge of the connexion we are seeking; and the President of the Royal Society considers that an additional epoch of coincidence has arrived, making the fourth decennial period; but some doubt is thrown upon these coincidences by the magnetic observations made at Greenwich Observatory. In a paper published in the *Transactions of the Royal Society*, 1863, the Astronomer Royal says, speaking of results extending over seventeen years, there is no appearance of decennial cycle in the recurrence of great magnetic disturbances; and Mr. Glaisher last year, in the physical section of this Association, stated that after persevering examination he had been unable to trace any connexion between the magnetism of the earth and the spots on the sun.

Mr. Airy, however, in a more recent paper, suggests that currents of magnetic force having reference to the solar hour are detected, and seem to produce vortices or circular disturbances, and he invites further co-operative observation on the subject, one of the highest interest, but at present remaining in great obscurity.

One of the most startling suggestions as to the consequence resulting from the dynamical theory of heat is that made by Mayer, that by the loss of *vis viva* occasioned by friction of the tidal waves, as well as by their forming, as it were, a drag upon the earth'a rotatory movement, the velocity of the earth's rotation must be gradually diminishing, and that thus, unless some undiscovered compensatory action exist, this rotation must ultimately cease, and changes hardly calculable take place in the solar system.

M. Delaunay considers that part of the acceleration of the moon'a mean motion which is not at present accounted for by planetary disturbances, to be due to the gradual retardation of the earth's rotation; to which view, after an elaborate investigation, the Astronomer Royal has given his assent.

Another most interesting speculation of Mayer is that with which you are familiar, viz., that the heat of the sun is occasioned by friction or percussion of meteorites falling upon it; there are some difficulties, not perhaps insuperable, in this theory. Supposing such cosmical bodies to exist in sufficient numbers, they would, as they revolve round the sun, fall into it, not as an aërolite falls upon the earth directly by an intersection of orbits, but by the gradual reduction in aize of the orbits, occasioned by a resisting medium; some portion of force would be lost, and heat generated in space by friction against such medium; when they arrive at the sun they would, assuming them, like the planets, to have revolved in the same direction, all impinge in a definite direction, and we might expect to see some symptoms of such in the sun's photosphere; but though this is in a constant state of motion, and the direction of these movements has been carefully investigated by Mr. Carrington and others, no such general direction is detected; and M. Faye, who some time ago wrote a paper pointing out many objections to the theory of solar heat being produced by the fall of meteoric bodies into the sun, has recently investigated the proper motions of sun-spots, and believes he has removed certain apparent anomalies, and reduced their motions to a certain regularity in the motion of the photosphere, attributable to some general action arising from the internal mass of the sun.

It might be expected that comets, bodies so light and so easily deflected from their course, would show some aymptoma of being acted on by gravitation, were such a number of bodies to exist in or near their paths, as are presupposed in the mechanical theory of solar heat.

Assuming the undulatory theory of light to be true, and that the motion which constitutes light is transmitted across the interplanetary spaces by a highly elastic ether, then, unless this motion is confined to one direction, unless there be no interference, unless there be no viscosity, as it is now termed, in the medium, and consequently no friction, light must lose something in its progress from distant luminous bodies, that is to say, must lose something as light; for, as all reflecting minds are now convinced that force cannot be annihilated, the force is not lost, but its mode of action is changed. If light, then, is lost as light (and the observations of Struvé seem to show this to be so, that, in fact, a star may be so far distant that it can never be seen in consequence of its luminous emissions becoming extinct), what becomes of the transmitted force lost as light, but existing in some other form? So with heat: our sun, our earth, and planets are constantly radiating heat into apace, so in all probability are the other suns, the stars, and their attendant planets. What becomes of the heat thus radiated into space? If the universe have no limit, and it is difficult to conceive one, there is a constant evolution of heat and light; and yet more is given off than is received by each cosmical body, for otherwise night would be as light and as warm as day. What becomes of the enormous force thus apparently non-recurrent in the same form? Does it return as palpable motion? Does it move or contribute to move suns and planets? and can it be conceived as a force similar to that which Newton speculated on as universally repulsive and capable of being substituted for universal attraction? We are in no position at present to answer such questions as these; but I know of no problem in celestial dynamics more deeply interesting than this, and we may be no further removed from its solution than the predecessors of Newton were from the simple dynamical relation of matter to matter which that potent intellect detected and demonstrated.

Passing from extra-terrestrial theories to the narrower field of molecular physics, we find the doctrine of correlation of forces steadily making its way. In the Bakerian Lecture for 1863 Mr. Sorby shows, not perhaps a direct correlation of mechanical and chemical forces, but that when, either by solution or by chemical action, a change in volume of the resulting substance as compared with that of its separate constituents is effected, the action of pressure retards or promotes the change, according as the substance formed would occupy a larger or a smaller space than that occupied by its separate constituents; the application of these experiments to geological inquiries as to subterranean changes which may have taken place under great pressure, is obvious, and we may expect to form compounds under artificial compression which cannot be found under normal pressure.

In a practical point of view the power of converting one mode of force into another is of the highest importance, and with reference to a subject which at present, somewhat prematurely perhaps, occupies men's minds, viz., the prospective exhaustion of our coal-fields, there is every encouragement derivable from the knowledge that we can at will produce heat by the expenditure of other forces; but, more than that, we may probably be enabled to absorb or store up as it were diffused energy—for instance, Berthelot has found that the potential energy of formate of potash is much greater than that of its proximate constituents, caustic potash and carbonic oxide. This change may take place spontaneously and at ordinary temperatures, and by such change carbonic oxide becomes, so to speak, reinvested with the amount of potential energy which its carbon possessed before uniting with oxygen, or, in other words, the carbonic oxide is raised as a force-possessor to the place of carbon by the direct absorption or conversion of heat from surrounding matter.

Here we have as to force-absorption, an analogous result to that of the formation of coal from carbonic acid and water; and though this is a mere illustration, and may never become economical on a large scale, still it and similar examples may calm apprehension as to future means of supplying heat, should our present fuel become exhausted. As the sun's force, spent in times long past, is now returned to us from the coal which was formed by that light and heat, so the sun's rays, which are daily wasted, as far as we are concerned, on the sandy deserts of Africa, may hereafter, by chemical or mechanical means, be made to light and warm the habitations of the denizens of colder regions. The tidal wave is, again, a large reservoir of force hitherto almost unused.

The valuable researches of Professor Tyndall on radiant heat afford many instances of the power of localising, if the term be permitted, heat which would otherwise be dissipated.

The discoveries of Graham, by which atmospheric air, drawn through films of caoutchouc, leaves behind half its nitrogen, or, in other words, becomes richer by half in oxygen, and hence has a much increased potential energy, not only show a most remarkable instance of physical

molecular action, merging into chemical, but affords us indications of means of storing up force, much of the force used in working the aspirator being capable at any period, however remote, of being evolved by burning the oxygen with a combustible.

What changes may take place in our modes of applying force before the coal-fields are exhausted it is impossible to predict. Even guesses at the probable period of their exhaustion are uncertain. There is a tendency to substitute for smelting in metallurgic processes, liquid chemical action, which of course has the effect of saving fuel; and the waste of fuel in ordinary operations is enormous, and can be much economised by already known processes. It is true that we are, at present, far from seeing a practical mode of replacing that granary of force the coal-fields; but we may with confidence rely on invention being in this case, as in others, born of necessity, when the necessity arises.

Two very remarkable applications of the convertibility of force have been recently attained by the experiments of Mr. Wilde and Mr. Holz; the former finds that, by conveying electricity from the coils of a magneto-electric machine to an electro-magnet, a considerable increase of electrical power may be attained, and by applying this as a magneto-electric machine to a second, and in turn to a third electro-magnetic apparatus, the force is largely augmented. Of course, to produce this increase, more mechanical force must be used at each step to work the magneto-electric machines; but provided this be supplied there hardly seems a limit to the extent to which mechanical may be converted into electrical force.

Mr. Holz has contrived a Franklinic electrical machine, in which a similar principle is manifested. A varnished glass plate is made to revolve in close proximity to another plate having two or more pieces of card attached, which are electrified by a bit of rubbed glass or ebonite; the moment this is effected a resistance is felt by the operator who turns the handle of the machine, and the slight temporary electrisation of the card converts into a continuous flood of intense electricity the force supplied by the arm of the operator.

These results offer great promise of extended application; they show that, by a mere formal disposition of matter, one force can be converted into another, and that not to the limited extent hitherto attained, but to an extent co-ordinate, or nearly so, with the increased initial force, so that, by a mere change in the arrangement of apparatus, a means of absorbing and again eliminating in a new form a given force may be obtained to an indefinite extent. As we may, in a not very distant future, need, for the daily uses of mankind, heat, light, and mechanical force, and find our present resources exhausted, the more we can invent new modes of conversion of forces, the more prospect we have of practically supplying such want. It is but a month from this time that the greatest triumph of force-conversion has been attained. The chemical action generated by a little salt water on a few pieces of zinc will now enable us to converse with inhabitants of the opposite hemisphere of this planet, and

"Put a girdle round about the earth in forty minutes."

The Atlantic Telegraph is an accomplished fact.

In physiology very considerable strides are being made by etudying the relation of organised bodies to external forces; and this branch of inquiry has been promoted by the labours of Carpenter, Bence Jones, Playfair, E. Smith, Frankland, and others. Vegetables acted on by light and heat, decompose water, ammonia, and carbonic acid, and transform them into, among other substances, oxalate of lime, lactic acid, starch, sugar, stearine, urea, and ultimately albumen; while the animal reverses the process, as does vegetable decay, and produces from albumen, urea, stearine, sugar, starch, lactic acid, oxalate of lime, and ultimately ammonia, water, and carbonic acid.

As, moreover, heat and light are absorbed, or converted in forming the synthetic processes going on in the vegetable, so conversely heat and sometimes light is given off by the living animal; but it must not be forgotten that the line of demarcation between a vegetable and an animal is difficult to draw, that there are no single attributes which are peculiar to either, and that it is only by a number of characteristics that either can be defined.

The series of processes above given may be simulated by the chemist in his laboratory; and the amount of labour which a man has undergone in the course of twenty-four hours may be approximately arrived at by an examination of the chemical changes which have taken place in his body; changed forms in matter indicating the anterior exercise of dynamical force. That muscular action is produced or supported by chemical change would probably now be a generally accepted doctrine; but while many have thought that muscular power is derived from the oxidation of albuminous or nitrogenised substances, several recent researches seem to show that the latter is rather an accompaniment than a cause of the former, and that it is by the oxidation of carbon and hydrogen compounds that muscular force is supplied. Traube has been prominent in advancing this view, and experiments detailed in a paper published this year by two Swiss professors, Drs. Fick and Wislicenus, which were made by and upon themselves in an ascent of the Faulhorn, have gone far to confirm it. Having fed themselves before and during the ascent upon starch, fat, and sugar, avoiding all nitrogenised compounds, they found that the consumption of such food was amply sufficient to supply the force necessary for their expedition, and that they felt no exhaustion. By appropriate chemical examination they ascertained that there was no notable increase in the oxidation of the nitrogenised constituents of the body. After calculating the mechanical equivalents of the combustion effected, they then state, as their first conclusion, that "the burning of protein substances cannot be the only source of muscular power, for we have here two cases in which men performed more measurable work than the equivalent of the amount of heat, which, taken at a most absurdly high figure, could be calculated to result from the burning of the albumen."

They further go on to state that, so far from the oxidation of albuminous substances not being the only source of muscular power, "the substances by the burning of which force is generated in the muscles, are not the albuminous constituents of those tissues, but non-nitrogenous substances, either fats or hydrates of carbon," and that the burning of albumen is not in any way concerned in the production of muscular power.

We must not confuse the question of the food which gives permanent capability of muscular force with that which supplies its requisites for temporary activity; no doubt the carnivora are the most powerfully constituted animals, but the chamois, gazelle, &c., have great temporary capacity for muscular exertion, though their food is vegetable; for concentrated and sustained energy, however, they do not equal the carnivora; and with the domestic graminivora we certainly find that they are capable of performing more work when supplied with those vegetables which contain the greatest quantity of nitrogen.

These and many similar classes of research show that in chemical inquiries, as in other branches of science, we are gradually relieving ourselves of hypothetical existences, which certainly had the advantage that they might be varied to suit the requirements of the theorist.

Phlogiston, as Lavoisier said with a sneer, was sometimes heavy, sometimes light; sometimes fire in a free state, sometimes combined; sometimes passing through glass vessels, sometimes retained by them; which by its protean changes explained causticity and non-causticity, transparency and opacity, colours and their absence. As phlogiston and similar creations of the mind have passed away, so with hypothetic fluids, imponderable matters,

specific ethers, and other inventions of entities made to vary according to the requirements of the theorist, I believe the day is approaching when these will be dispensed with, and when the two fundamental conceptiona of matter and motion will be found sufficient to explain physical phenomena.

ACADEMY OF SCIENCES.

August 13.

M. Pasteur announced to the Academy that he is about to publish a work "*On the Diseases of Wines and the Means of preventing them.*"

M. Chevreul read an extract from the second volume of his history of chemical knowledge. He called it "*An Historic Note on the Age of Stone,*" and it contained an extract from the life of Confucius by Father Amyott which proved to the author that 1122 years before Christ there was among the Chinese a tradition that stone arrow-heads had been in use in the country. Extracts from a Chinese dictionary and other works confirmed M. Chevreul in his opinion, since they showed that stone implements had been found in various provinces of China, and, indeed, spoke of them as being in actual use. What this has to do with chemistry is not very clear.

M. J. Jannsen communicated an interesting memoir "*On the Spectrum of Aqueous Vapour.*" The author's observations were made with an iron tube thirty-seven metres long filled with steam under a pressure of seven atmospheres. The light was furnished by sixteen gas jets. The spectrum showed five dark bands, of which two well marked answered to D and A (Fraunhofer), and reminded the observer of the solar spectrum seen in the same instrument towards sunset. According to the first comparisons made between the spectrum of steam and that of solar light it appeared that the group A of Fraunhofer, B (in great part at least), the group C, two groups between C and D are due to the aqueous vapour in the atmosphere. The experiment gave another interesting result. The spectrum was very dark at the violet end, and brilliant in the red and yellow, showing that aqueous vapour is very transparent to the latter rays, and suggesting that it will appear orange-red by transmission, and redder according to the thickness of the layer. This result, the author states, requires to be verified with care, but if established, he says, it will explain the redness always observed at sunrise and sunset. M. Jannsen hopes soon to be in a position to pronounce upon the existence or non-existence of aqueous vapour in the atmospheres of the planets and other stars. At present he is only able to say that it is not present in the atmosphere of the sun.

Readers interested in the subject will find in the *Compte Rendu* of the above date "*An Account of the actual State of the Waterworks of Paris.*"

M. J. Kolb presented a paper "*On the Densities of Nitric Acid.*" The author found reason to doubt the accuracy of all the tables he had met with, and made a series of determinations with all precautions for himself. His results are given in a long table, for which we will, if possible, find space.

NOTICES OF BOOKS.

Journal de Pharmacie et de Chimie. August, 1866.

The present number of this journal opens with the preface to the new edition of the French *Codex Medicamentarius*, just ready to be issued. It is an eloquently written account by M. Dumas of the uses of a Pharmacopœia, and the objects to be kept in view in the composition of such a work. The whole well deserves perusal, but we have only room for an extract relating to the part that chemistry is called upon to play in the preparation and application of medicines.

"Chemistry continues to improve the modes of preparation, of purification, of concentration of known medicaments. It isolates everyday active principles; it creates and multiplies to infinity substances that rival them in activity. It is no longer contented to prepare with accuracy the remedies that practice demands, but it pursues their course through the animal economy; it ascertains the modifications they undergo during their stay in the organs of the body, as well as the forms under which they are eliminated. It teaches the practitioner to foresee under what circumstances an inoffensive remedy may become a mortal poison, and, in its turn, how a poison may become inert. It furnishes us with facts and views which allow us in a great number of cases to point out beforehand on what organs or what system of organs a medicament will exert its influence, by what general processes its elimination will take place, and consequently what will be the limits and probable duration of its action." Again: "Chemistry will show then how we purify and how we concentrate active principles; experimental physiology will teach to what precise organs the medicament addresses itself, and what variations its effects undergo, according to the formulæ adopted for its preparation or its employment. With regard to energetic substances, the art of healing will be informed by the studies of the chemist of the means to obtain them pure, to avoid associations which change them, to choose those which favour their preservation or assure their efficacy; the studies of the physiologist will teach the exact part they play, what field their action embraces, and what limits their power acknowledges. Thus, medicines with a simple effect, of physiological origin, will increase in number and importance, while complex medicaments transmitted by tradition will lose their authority. We shall no longer seek to weaken and dilute opium by distributing it through a mass of theriacum; but, on the contrary, shall endeavour to remove from the crude product the inert matter, distinguishing each active principle in it, and defining still better the specific action of morphia, codeia, narcotine, narceine, &c."

We shall only make one more quotation, which applies to pharmaceutists, and makes special reference to England and present disputes in France. "The object is to administer medicines brought to their maximum of energy and consequently of danger under the best conditions to guarantee the safety of their employment, and the certainty of their action on an organ, or even on a well-defined element of the organism, and some would do away with well-instructed pharmaceutists! The physician prescribes hydrocyanic acid or pepsine, for example, and it matters little that the seller of these articles knows enough to assure himself whether his hydrocyanic acid is the most violent of poisons or the most harmless of matters—whether the pepsine he vends is the true ferment of the gastric juice or a powder without virtue! With increased responsibility an increase of knowledge is necessary. To what dangers are not families exposed if the pharmaceutist is ignorant that the name chloride of mercury may designate either a violent poison or an innocent purgative, and that there is nothing in common between chloride and cyanide of potassium so easily confounded by common people. The pharmaceutist, let us say, requires a more extended and deeper instruction in proportion as the progress in therapeutics places in his hands medicines more numerous, more powerful, more changeable, more easy to adulterate, with regard to which the least error threatens the life of the patient, and the slightest modification mars the hope of the physician. When this conviction takes root in England herself, enlightened by the mistakes which multiply under her eyes, and the evils they involve, it is not the moment that France should choose to abandon it."

We do not hold the same views as M. Dumas respecting the "liberty of pharmacy;" but this is not the time to argue

with him. His remarks will meet with the approval of many in England, and we quote them for the advantage of those who agree with the author. The next article is by M. Guibourt "*On the Productions of Mexico*," a paper communicated to the Pharmaceutical Society of Paris.

The next paper is an extract from a thesis by Dr. A. Commaille, entitled "*Researches on the Chemical Constitution of Albumenoid Substances.*" The author has isolated the various constituents of compound albumenoid substances. Thus in gluten he finds five nitrogenised principles. 1. *Inésine* (the fibrin of gluten). 2. *Sitésine* (the casein of gluten). 3. *Glutine*. 4. *Mucine*. 5 *Sitosine* (the albumen of gluten). He describes the properties of these, and gives analyses of their chloroplatinic compounds. In like manner he describes the albuminous matters of eggs, of sweet almonds, of leguminous seeds, of milk, of muscular flesh, of the blood, and of the urine. With regard to white of egg, the author points out that raw albumen differs chemically as well as physically from coagulated. It has a different solubility in dilute acids, and it is certain that heat causes the elimination of a small quantity of a peculiar substance, which is only imprisoned in the coagulated mass. This fact was pointed out by Bostock in 1808. A culinary experiment shows that cooking effects a dissociation of the principles of white of egg, or some peculiar change in the albumen. Silver is not affected in a raw egg, but everybody knows it is blackened in a boiled one. The author put a recently struck coin in white of egg, and then heated it to coagulation in a water bath. The coin came out not only blackened, but corroded in places. Nothing like this was observed with the raw egg, or with the yolk raw or cooked. M. Wurtz has pointed out that sulphuretted hydrogen is evolved during the coagulation of albumen, but the author is not certain that this gas alone gives the peculiar odour to hard eggs. He rather believes that there is a volatile substance which contains all the sulphur hitherto supposed to be a constituent of the albumen itself.

The albumenoid matter found in urine, he states, presents a close similarity to that found in the juice surrounding muscular fibre, and to which he has given the name "*Oposine.*"

In a short note "*On Thallium Amalgam*," M. Nicklés states that this metal, like all those which are, so to speak, *moistened* by mercury, is permeable to the latter metal.

Some papers from the *Comptes Rendus* and the *Proceedings of the Paris Pharmaceutical Society*—the latter of no interest—together with some medical papers, fill up the rest of the number.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

1633. W. B. Brown, Manchester, "An improved anti-acid oil."—Petition recorded June 16, 1866.

1838. J. Law, Queen's Road, Bayswater, London, "Decolorising the products obtained in the distillation of shale, coal, and wood, including tar, for the purposes of dipping, pouring, and smearing sheep, and thus preserving the purity of colour and the healthy condition of the wool."

1846. A. Prince, Trafalgar Square, Middlesex, "Improvements in the means of preserving timber from decay." A communication from G. P. Ball, New York, U.S.A.—July 13, 1866.

1917. G. Davies, Serle Street, Lincoln's Inn, Middlesex, "Improvements in the manufacture of sulphate of soda and sulphate of potash." A communication from P. Rémond, Paris.—July 24, 1866.

1969. F. C. Hills, Deptford, Kent, "Improvements in the manufacture of oxalic acid."—July 31, 1866.

Notices to Proceed.

933. W. B. Collis and E. J. Collis, Stourbridge, Worcestershire, "Improvements in coke ovens."—Petition recorded April 2, 1866.

983. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the production of white or semitransparent glass." A communication from Dr. H. Kunheim, Berlin.—April 5, 1866.

992. J. Young, Limefield, N.B., "Improvements in distilling."—April 6, 1866.

MISCELLANEOUS.

Method for Assaying the Purity of Arrowroot from the Maranta.—M. Albers (*Archiv der Pharm.* and *Dingler's Polytech. Jour.*) gives the following method for discovering the presence of wheat or potato starch in the arrowroot of the Maranta. The following is the process:—Take one part of fecula and mix it with three parts of a proof liquor, consisting of two parts of chlorhydric acid, sp. gr. 1·120, and one part of water at the ordinary temperature. In three or four minutes pure arrowroot will not be affected by the acid liquor, but wheat or potato starch, on the contrary, will be changed to a transparent gelatinous mass, which becomes fluid by the further action of the acid, transforming the starch jelly to dextrine. When potato starch is the adulterant, it evolves a peculiar odour, well known to those who have made dextrine from it. When a mixture thus exists, the true arrowroot granules will subside as the gelatinised adulterant is converted to dextrine, and may be separated by a strainer, washed, dried and weighed, and the relative amount of adulteration may be judged of approximately by the consistence of the jelly at first developed.—*Jour. de Pharm.*, 218, *Fevrier* 1866.

Yield of Essential Oils.—Zeise has distilled on a large scale, and gives the following as the yield calculated for 100 kilogrammes of the original material:—

Pimento, from 2½ to 3 kilos.
Bitter almonds, from 360 to 420 grammes.
Aniseed, 2 kilos.
Star anise, 4·15 to 4·44 kilos.
Cardamoms, 2·9 kilos.
Camomiles (Anthem. noh.), 275 grammes.
,, (Matricar. cam.), from 60 to 270 grs.
Cinnamon, from 420 grammes to 1·69 kilo.
Copaiba, 58 to 67 kilos.
Cubebs, 390 to 730 grammes.
Peppermint (dry), 680 grammes.
Juniper, 550 grammes.
Savine, 2·75 kilos.
Sassafras, ¾ kilo.

The distillation of cinnamon, the author says, used to be profitable, but now the yield of oil is small, owing to the practice of extracting the oil by steam in Ceylon, before the bark is sent to Europe.—*Journ. de Ph. et de Chim. Neues Rept. für Pharm.*, t. xv. p. 126.

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. *Private* letters for the Editor must be so marked.

The Answers to Correspondents are unavoidably deferred until next week.

Received.—"Aluminium;" T. C. E.

Books Received.—Ganot's Elementary Treatise on Physics, Experimental and Applied. Translated by E. Atkinson, F.C.S. Part II.

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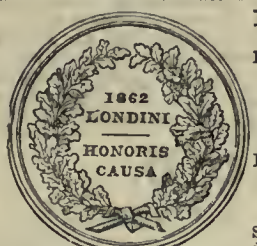

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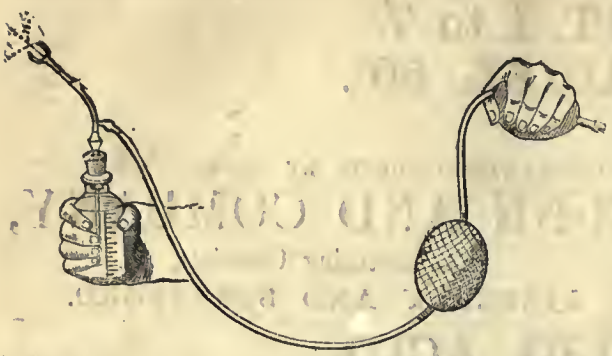

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THE

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AND

Journal of Physical Science.

Edited by] [*Wm. Crookes, F.R.S.*

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On a Process of Organic Elementary Analysis, by Combustion in a Stream of Oxygen Gas, by C. M. Warren.

(*Concluded from page* 87.)

4. As an additional control over the supply of oxygen, and serving also as a temporary safeguard against the escape of incompletely oxidised substance, in case of too rapid distillation, with an insufficient flow of oxygen, I have two or three inches in length of the tube filled with coarse, strongly ignited oxide of copper, placed in front of the asbestos, and this followed by a plug of the latter substance to keep it in place, and prevent the formation of a channel along the upper surface of the oxide of copper. The tube itself being laid in an iron trough, as previously described, with the upper half of the tube exposed, the oxide of copper is heated in such a manner that any reduction would be readily observed at the end in contact with the asbestos. In this manner it serves as a valuable indicator by which to determine at a glance whether the flow of oxygen is sufficient. It will rarely happen that any reduction of the oxide of copper will take place. I have, however, in some of my earlier experiments, with too short a column of asbestos, and ill-adapted bulbs, had so much of the oxide of copper reduced that combustible gases passed through the absorbing apparatus; and in one instance, when the unabsorbed gases were collected, the quantity of combustible gas was so considerable as to form with the oxygen collected with it—which of course came forward at an earlier or later stage of the process—an explosive mixture. Having seen no indications that any other than gaseous bodies escaped the combustion tube in such a case, it occurred to me that such an analysis might be saved by collecting the gas over mercury, and, at the close of the combustion, before detaching the absorbing apparatus, conducting it a second time through the combustion tube.* As a matter of economy, also, in the saving of the excess of oxygen, when a considerable number of analyses are to be made, this idea seemed to recommend itself; as the oxygen would, at the same time, become purified from any traces of combustible matter which might be present, and could then safely be collected as pure oxygen, and finally transferred to the oxygen gasometer.

I therefore constructed for this purpose the apparatus which is represented in the background of the figure (see Chem. News, p. 86) as attached to the anterior end of the absorption apparatus. At the close of the combustion, when only pure oxygen appears to enter the potash bulbs, the flow of oxygen is interrupted; the communication with that portion of the drying apparatus which is back of the short U tube, *A*, is closed at *b*; and the tube *B*—which is movable in the cork—turned up.† The joint at *c* is then disconnected; the end leading to the receiver *C* tightly closed with a piece of glass rod, and a communication established between the absorption apparatus and another receiver containing water—not shown in the figure—for collecting the pure oxygen. On opening the spring-clip *d* (the more modern form, which is provided with a fine screw, is excellently well adapted for this purpose), the mercury will flow from the reservoir *D* into the receiver *C*, and force the gas through the capillary tube *e e*; thence through the short U tube *A*, containing chloride of calcium, to the combustion tube and absorption apparatus; and the gas is finally collected over water in the receiver provided for that purpose.

The introduction of a longer column of oxide of copper would probably accomplish the same purpose with less expense; but neither expedient can be regarded as essential to the process. As the saving of an analysis by the use of a longer column of oxide of copper would only be occasional, the additional heat required, and consequent discomfort occasioned by its continual use, would hardly be compensated for. So that while I would not, therefore, recommend the use of an additional quantity of oxide of copper, I would also discard the other expedient of collecting the gas over mercury, or water, &c., unless the saving of the surplus oxygen, together with the additional security afforded, should be considered of sufficient importance to recommend it. As the passing through of the gas the second time requires no attention after it is once started, and occupies but a short time, during which the operator may attend to anything else, I much prefer, for myself, to retain in use that part of the process.

5. Some other less important peculiarities in the construction and use of the apparatus will now be noticed in connexion with some remarks on the performance of the analysis.

The posterior end of the combustion tube, as seen in the figure, is bent obliquely upward, as in the common form, except that instead of being drawn out to a point it is left of the full size of the tube. The object of this form is to prevent, in a great measure, the escape of oxygen during the time occupied in introducing the substance for analysis; and also for greater convenience and security from loss in the performance of this operation, especially in the case of volatile liquids. In the latter case the neck of the bulb—which has previously been provided with one or more scratches on its side near the end—is introduced into the end of the combustion tube, and broken off by pressure against the side of the tube; the bulb itself is then allowed to drop in, and the end of the tube immediately closed with a perforated cork containing a glass tube, *f*, connecting it with the drying apparatus. This connecting tube is constructed of hard Bohemian glass; the anterior end of which is drawn out to a short, blunt point, and the opening nearly closed in the blowpipe flame, to the size of a small needle; the object of which is, to increase the rapidity of the flow of oxygen at that point, and thereby diminish the liability to loss from diffusion of gases or vapour backward into the drying apparatus, which is always too liable to occur when the posterior end of the combustion tube is not sealed.

As an additional precaution against loss from this source, this connecting tube is packed with asbestos in the same manner as the combustion tube, and during the combustion is heated with one of Bunsen's burners. In case vapour of the substance should reach this tube, notwithstanding the above precaution against it, it could not reach the drying apparatus as such; but would be immediately decomposed, and the carbonic acid formed would at least stand a good chance of being carried for-

* As the time consumed in an experiment is so short, and the quantity of combustible gas present, if any, so very small, and that mixed with a very large quantity of oxygen, it is not improbable that the gas might as well be collected over water; as the quantity which could be absorbed by the water in so short a space of time would probably be inappreciable.

† That this tube may not operate as a siphon, the outer limb is formed by attaching near the bend a flexible tube, of larger bore than that of the glass tube. This flexible tube is preferable to glass on account of the readiness with which it adapts itself to any change of position of the glass tube, by which it may always project into the receiver underneath, and prevent waste of mercury.

ward, and prevent a loss in the determination of the carbon. The heating of this connecting tube may be superfluous for the object above described (a point which I have not yet taken the time to determine); but it certainly has the good effect of heating the oxygen, and thus preventing the condensation of liquid at the cork in the end of the combustion tube.

In the performance of an analysis, the first step should be to expel the moisture from the combustion tube, while hot, by passing through it, for some time, a stream of dry air from the gasometer.‡ The tube should then be filled with oxygen, before the substance, if volatile, is added; as otherwise particles of unburnt substance might escape during the displacement of the air, and occasion loss. The absorbing apparatus, having been previously weighed, is then attached, and, if the excess of oxygen employed is to be saved, the oxygen again admitted to expel the air from the absorbing apparatus. The connexion is then made with the receiver *C*, if used, and the tightness of the joints tested by turning down the tube *B*, so as to partially exhaust the apparatus. If found tight, as indicated by the liquid in the potash bulbs, the tube *B* is again turned up, and the substance then introduced in the manner above described. A very slow stream of oxygen is now admitted; the tube *B* again turned down till the level of mercury in this tube shall be half an inch to an inch below the level of mercury in the receiver *C*; and from time to time during the combustion the position of this tube is adjusted so as to preserve about this difference between the levels of the mercury, or at least so as to prevent the mercury in the tube from ever rising above that in the receiver.

In this manner the mercury, instead of offering resistance to the passage of gas from the combustion apparatus, and thus increasing the internal pressure upon the joints, which would be objectionable, actually operates advantageously by producing partial exhaustion, and thus diminishing the internal pressure upon the joints, and consequently the liability to leakage. The distillation of the substance is now commenced, and conducted as previously detailed above. So soon as condensation of moisture appears in the neck of the chloride of calcium tube, indicating that combustion has commenced, the flow of oxygen may be gradually accelerated to keep pace with the progress of the combustion, as indicated by the bubbles in the potash bulbs. When the burning of the subtance seems to have been completed, heat is gradually applied, for a short time, along the whole length of the column of asbestos, to obviate the possibility of any loss from unburnt substance.

The absorbing apparatus may be weighed filled with either oxygen or air; for myself I prefer the latter, as, on the whole, more convenient and less liable to lead to error. At the close of the analysis, therefore, I expel the oxygen from the apparatus by admitting air from the air-gasometer,§ saving for further use the oxygen which is expelled during the first five or six minutes. Thus far I have applied this process only in the analysis of volatile hydrocarbons of the formula C_nH_{n-6}; $C\ H_{n+2}$, &c.‖ As a mixture of the vapours of these bodies with oxygen is highly explosive, a more severe test of the safety of the process could not be applied.

In every experiment which I have made, the combustion has proceeded as quietly as if burning in the open air. The results obtained are extremely accurate and uniform.

Although the bodies which I have analysed represent but a single class of organic substances, I can see no reason to doubt that the process will apply equally well in the generality of cases.

If this view be corroborated by actual experiment, the process can hardly fail to supplant the common methods, if for no other reasons than its greater convenience, economy of time, avoidance of excessive heat, neatness, &c.; while, as regards accuracy of results, it will, at least, not be found inferior to the other methods; but, on the contrary, I think preferable, as affording greater security against failures and errors from accidental causes.

Having obtained such satisfactory results in the cases referred to, and being prevented by other important work, to which the study of this process is only incidental, from pursuing the subject further at present (except so far as I shall have occasion to use the process in my other investigations), I have thought it advisable to present the process to the Academy as it now stands. I hope, however, before long to be able to resume the work, with the view to determine, by experiment, the extent of its applicability as a general method, and will report the results to the Academy.

‡ The necessity for this may be entirely obviated, after the first analysis, and much time saved and uncertainty avoided, by connecting the anterior end of the combustion tube, at the close of a day's operations, with a set of stationary drying tubes of ample capacity, which may stand back of the furnace out of the way, communication with which is established by means of a flexible tube. Or, better, a movable tube may be attached by means of a screw to the opening in the top of the gasometer, extending to the top of the upper reservoir, so that water cannot enter, and then, by simply turning the cock underneath, communication would be opened between the surrounding air and the combustion tube, through the intervening drying apparatus. At the close of work the anterior end of the combustion tube should then be tightly corked, the fire extinguished, and the tube allowed to cool in dry air. It would thus be always ready for immediate use.

§ The oxygen-gasometer and the air-gasometer each having a separate drying apparatus, the time consumed in changing from one to the other is very much shortened, as the necessity for displacement of the oxygen or air—as the case may be—which is contained in the drying apparatus is avoided. Each drying apparatus consists—1st, of Liebig's bulbs, containing sulphuric acid; 2nd, of a U tube, fifteen inches high (nearly three feet of tube), filled with soda-lime for carbonic acid; and 3rd of two such U tubes (five to six feet of tube), filled with chloride of calcium. The object in using drying tubes of such large dimensions is to avoid the necessity of too frequent renewal. The gasometers stand in a pan of copper, which is provided with an outlet to the sink, so that they may be filled without disconnecting from the drying apparatus; thus giving a degree of permanence to the apparatus, and saving some labour.

‖ In an analysis of amyl-alcohol, made in my laboratory by my friend Mr. Storer, for the sake of familiarising himself with the process,—it being his first analysis by this apparatus,—the following result was obtained:—

	Experiment.	Theory.
Carbon . . .	68·53	68·18
Hydrogen . . .	13·63	13·64

TECHNICAL CHEMISTRY.

On the Assay of Coal, &c., for Crude Paraffin Oil, and of Crude Oil and Petroleum for Spirit, Photogen, Lubricating Oil, and Paraffin, by John Attfield, *Ph.D., F.C.S., Director of the Laboratory of the Pharmaceutical Society of Great Britain.**

The enormous increase, during recent years, in the use of oils of mineral origin for lighting, lubricating, and other purposes, has so stimulated the demand for these liquids, that analytical chemists are often required to determine the value of a specimen of coal, shale, lignite, &c., as a source of crude paraffin oil, or the value of a specimen of the oil itself, or of the allied substance of natural origin termed petroleum. Hitherto there has not been published any detailed method of conducting these examinations. The author, therefore, having from

* Read before the Chemical Section of the British Association, Nottingham meeting.

time to time had occasion to make a large number of such assays, ventures to supply the deficiency.

First, with regard to the assay of coal and other carbonaceous matters for crude oil. The method of manufacturing crude oil on the large scale consists, as is well known, in simply heating the coaly matter in large retorts; oil, water, and gas then distil off, and are collected in suitable receivers, while coke remains in the retort. Now, the object of the analyst in experimenting on small quantities of oil-yielding materials of unknown value must be to accurately imitate this process, while, at the same time, he provides for the collection of products of all possible variety of character. It has been stated that a good indication of the value of such materials may be obtained by placing ten or twenty grammes in a porcelain crucible, embedding the latter in charcoal contained in a much larger common crucible, and heating the whole in an ordinary furnace for an hour or two. Volatile matters then pass off, and coke, prevented from burning by the surrounding charcoal, remains in the inner crucible. When cold the coke is weighed, and the difference between this and the original weight of coal used gives the proportion of volatile matters. The facility with which such an experiment may be made has led to its frequent performance; the result is that one may see in books, &c., devoted to this subject, long columns of figures showing the proportion of volatile to non-volatile matter in a large number of oil-yielding substances. Probably, however, but little confidence can be placed in such results. A very small percentage of volatile matter would of course at once indicate that the substance operated on was of no value as a source of oil. Under all other circumstances the experiment is of little or no value, for I have found that the relative proportions of oil, water, and gas in volatile matter vary so greatly, that of much volatile matter but little may prove to be oil, and of a small percentage of volatile matter nearly all may be oil; and, again, the difficulty of applying a low and regular heat to such an arrangement of crucibles is so considerable, that I have met with differences of 10 to 15 per cent. of coke from the same sample of broken and previously well-mixed coal. In one experiment four porcelain crucibles were placed in one large common crucible, the first porcelain crucible being placed near the bottom, and the three others in the upper part, and all charged with the same prepared specimen of coal. After ignition, the lower crucible yielded 9 per cent. more coke than the others; owing mainly, doubtless, to its receiving more heat than they—a high temperature, as is well known, causing decomposition of some of the hydrocarbons, of which oil and gas are formed, with separation of solid carbon.

Rejecting, then, the experiment of subjecting the coal, &c., to a preliminary coking operation, the material is at once subjected to distillation. This I usually perform in a piece of common iron gas-piping, a metre and a quarter long, and five to eight centimetres internal diameter. Two or three kilogrammes of the coal, properly sampled, is then broken down to the size of peas or hazel nuts, avoiding the formation of dust. The fragments are well mixed together, and from one-half to one kilogramme weighed out for distillation. This quantity is poured into one end of the iron tube, a diaphragm of wire gauze, suspended by a long wire at about thirty centimetres from the other end of the tube, preventing the coal from falling through. The coal so placed occupies half a metre or more of the tube, leaving a free space of thirty or forty centimetres at either end of the tube. The region of the tube occupied by coal is now heated by a series of gas-jets until the lowermost part of the iron is just visibly red in a darkened room, the gas-jets being turned off during the moment of observation of the temperature. To heat the tube equally and not too highly by charcoal is difficult. A Hofmann's gas furnace, two-thirds of a metre long and having three rows of burners is perhaps the most convenient for the purpose; it should be just fairly alight along its whole surface. These arrangements are, in my opinion, those most convenient for quantitative experiments; if the object be merely the production of oil, a wider tube and a furnace of five rows of burners may be used. For experimental purposes, the iron tube and furnace should, I think, in nearly all cases be inclined downwards from the horizontal position at an angle of ten or fifteen degrees. Indeed, one office filled by the wire-gauze diaphragm already alluded to is to prevent the falling of the coal out of the region of the furnace when the iron tube is inclined as just stated. The advantage of inclining the tube is, that while nothing is lost which could possibly be formed in or obtained from a retort of the usual form, some of the paraffin and heavier vapours, which might under other circumstances remain about the source of heat, and become decomposed mainly into gas, at once flow off downwards from the region of danger. The condensation of the vapours produced in the distillation is effected in a common bottle of one or two litres' capacity, partially immersed in a vessel of cold water, a wet cloth covering the upper surface of the bottle and dipping into the water. This arrangement is usually sufficient even for the condensation of oils from coals containing a considerable amount of moisture. The iron retort tube is connected with the bottle by a hollow tin cone about a third of a metre long, the larger orifice fitting loosely over the end of the iron tube, the smaller passing through a cork into the condensing bottle. The neck of a broken retort, commonly used as an adaptor in laboratory distillations, may be used in place of the tin cone, but is more than usually liable to fracture. The tin is luted to the iron by plaster of Paris, or, still better, linseed meal, which, being some distance from the source of heat, is more effective than might be supposed. The opposite end of the iron tube is closed by a cork, which also, being from twenty-five to thirty centimetres from the furnace, is scarcely charred in several operations. The cork of the condensing bottle should be perforated by a second hole for the insertion of a glass tube for carrying off gas, or for connexion with a second condensing bottle. The second bottle may, in the distillation of coal yielding much very volatile matter, be connected with a Liebig's condenser. But if the operation be conducted slowly, extending over about two hours, the whole of the product will, in nearly every case, be found in the first bottle. The gas produced in the process may be conducted into a chimney, burned at a jet, or collected in a gas-holder for measurement and experiment.

I have had constructed other forms of retort than the long iron tube just described, but have not found them to possess any particular advantage. In one, the furnace being placed horizontally, the tube at the point where it emerged from the source of heat on the condensing side was bent upwards for about ten centimetres, and then downwards, so as to resemble the neck and beak of an ordinary glass retort. In some comparative experiments this form of retort yielded oil somewhat better in quality, but slightly smaller in quantity, than that given by the inclined straight tube. This result was probably simply due to the exclusion of the

heaviest hydrocarbons, an effect said to be sometimes desired by the manufacturer, but to be generally avoided by the experimentalist, who should be careful to obtain from a coal, etc., everything volatile that it can in any way be made to yield. Another retort, similar in form to the last mentioned, was provided with a tube for the admission of steam, under the conjecture that the escape of oil-vapour as fast as produced might be thereby facilitated, as in the corresponding operation for the extraction of the ready-formed volatile oil of seeds, fruits, etc. But an experiment with the same coal as used in the other cases showed that the use of steam did not cause a better yield of oil, and was attended by some inconvenience, owing to the necessity of adopting adequate condensing arrangements. The use of superheated steam has been proposed, and is used to some extent, I am told, in the distillation of oil from coal on the large scale, no external heat being applied to the retorts. What direct or indirect advantage is thereby gained I am unable to state, not having performed any experiments in this direction. It may assist in the escape of the heavier vapours, but for this purpose the analyst will find carbonic acid gas preferable, as will be presently seen. Should the use of steam at a temperature approaching redness ever be demonstrated to cause such an increase in the yield of oil as to counterbalance the increased cost of condensation, it would be easy for the analyst to imitate the method on the small scale, by passing steam generated in an ordinary flask through a heated coil of metal pipe before entering the retort containing the coal.

The distillation of the coal completed, the source of heat is removed, and the weight of the condensing bottle and its contents noted; from this weight that of the bottle previously ascertained is deducted, and the weight of the crude oil and water yielded by the coal thus determined. The separation of the oily from the aqueous portion of the distillate is generally easy of accomplishment. The bottle is placed in a vessel of cold water, which is then heated to from 30° to 60° C., for an hour or two, and allowed to cool slowly. If complete separation of oil and water has apparently occurred, the latter may now be siphoned off, or, if the oil is semi-solid, the water may be simply poured off, and the weight of the two be respectively determined. If desired, the water can then be examined for ammonia, &c. Sometimes the separation of oil and water is not so decided as is necessary for analytical purposes. Under these circumstances, a portion only is removed for examination, and a strong aqueous solution of common salt poured into the bottle; the whole is then well shaken, and again heated as before described. The superior specific gravity of the brine now enables the oil to rise to the surface. After standing a few hours, the brine is carefully removed by a siphon. The weight of the oil deducted from the weight of the original distillate gives the weight of the water. The retort having cooled, the coke is removed and weighed, and a portion burnt for ash or otherwise examined. And now the difference between the combined weights of oil, water, and coke, and the quantity of coal originally taken gives the weight of the gases evolved in the operation. From these weights the percentage or any other proportions are easily calculated. In English commerce, conventionality requires that the oil value of a coal be stated by giving the number of gallons of oil yielded by one ton of the coal. This is readily accomplished by calculating from the centesimal proportions the number of pounds of oil per ton of coal; the specific gravity of the oil is then ascertained in the usual way; and now the number of pounds, divided by the figures representing the specific gravity, indicate the number of gallons afforded per ton.†

The value of the crude oil is next determined. A specimen of natural mineral oil or petroleum requires similar treatment. This is a matter of fractionation with or without previous distillation, with or without previous purification. As a general rule it is best to at once distil about fifty cubic centimetres of the rough oil in a small glass retort, a thermometer being inserted in the liquid and the distillate allowed to flow into a cubic centimetre measure. By watching the thermometer, and roughly noting the amount of products yielded at different temperatures as the thermometer rises to 250° C., and, after removing the thermometer, at temperatures above 250° C., a fair indication of the character of the oil is obtained. A specimen of "once-run" oil is also thus secured, the appearance and specific gravity of which should be observed. The residue in the retort should have been so heated as to be but a carbonaceous, friable mass; when cold it may be removed and weighed. If the residue form only 2 or 3 per cent. of the crude oil, and the latter was not of very dark colour, then the crude oil may probably be submitted to the process of purification without previous distillation, but if the loss is 10 or 12 per cent. it is an indication that the crude oil should be "once run" before purifying. Sometimes the contents of the retort towards the close of this first experimental distillation assume the appearance of melted pitch; in that case a portion should be removed by a glass rod, and if, when cold, it is hard, black, and lustrous, the distillation should be stopped, and the amount of the pitch (asphalte) ascertained by weighing the retort and contents and subtracting therefrom the weight of the retort previously noted; or, if the retort has not been already tared, as much of the contents as possible may be poured out, the retort then cleaned with naphtha, and, when dry, weighed. If the first specimen of pitch removed from the retort does not become hard, the distillation should be continued some time longer. The vapours which are evolved above 250° C. are very heavy, and only distil with difficulty from such a retort as just described, even though the glass be in direct contact with an air-gas flame. After removing the thermometer, therefore, I usually insert in its place a glass tube, through which a current of carbonic acid gas is passed; in such an atmosphere the heavy paraffin and other vapours rise and flow off better than in a current of steam. A fifth of a litre of the once-run oil, or of the crude oil or petroleum, if not of very bad odour or colour, is now mixed with about ten cubic centimetres of strong sulphuric acid, and agitated frequently during a period of from two to three hours. The mixture is set aside for the oil and acid to separate, the oil poured off from the thick treacle-like deposit ("foots"), washed two or three times with water, and then shaken with about the same quantity of a strong solution of caustic acid (sp. gr. 1·3 or 1·4) for an equal period. The soda solution having subsided, the oil is poured off and washed by agitation with water. If the oil is still of bad colour, it is again treated with acid and soda as before, at a moderately warm temperature (30° to 35° C.); and sometimes a third treatment is necessary. Sometimes,

† The heavier the oil, the smaller amount of photogen it will yield, for the specific gravity of the latter should range as low as from 0·790 to 0·825; crude oils above 0·900, or "once-run" oils above 0·880, are not yet viewed with much favour in the market, unless, by their solidity, obviously containing much paraffin. Their value as lubricating oil will, however, probably rise to that of burning oil, when the use of the latter becomes more extended.—J. A.

also, the oil is best treated by soda first and acid afterwards. It is now redistilled in the manner already described, three chief fractions being collected separately, the volume of each noted, and its specific gravity taken. The fraction of lowest boiling-point, the "spirit," may in this first fractionation have a specific gravity of 0·750; the next, the burning-oil or "photogen," of 0·850; the "lubricating oil" will be the fraction coming over at the highest temperatures. Each of these fractions may now be once redistilled; the spirit will yield some photogen, which may be mixed with the photogen first obtained; the photogen will then, at the commencement of the distillation, yield a little spirit, and, towards the end, some lubricating oil, which may be mixed with the lubricating oil first obtained; the lubricating oil will then yield a little more photogen. The spirit should finally have a specific gravity only a few degrees above or below 0·730, and the photogen be within 10° or 15° of 0·805 and not give off inflammable vapour when at a temperature of about 40° C.‡ The specific gravity of the *lubricating oil* will vary. A fifth of a litre of crude oil having been used, the number of cubic centimetres of the three fractions divided by 2 will of course give the percentage volumes (in England gallons) of each product, the difference between these and 100 being the loss that has occurred during purification or "refining." In some cases this loss may be decreased by boiling together the two residues or "foots" of the acid and alkaline treatment and well washing the resulting "coarse grease" with water. The lubricating oil may also, if semi-solid at temperatures between 15° and 20° C., be further separated into oil proper and *paraffin*. To this end 100 grammes are distilled so long as the distillate, tried in quantities of 2 or 3 c. c. at a time, gives no crystals of paraffin on being cooled to 5° C. When this point is reached, the residue in the retort is poured out into a cup and cooled. The resulting solid fat ("lubricating grease") is then removed, wrapped in a sheet of unsized paper, and placed in a small press having hollow metal face-plates. Ice-water is now passed through the press-plates, and when sufficient time has elapsed for the fat to become cooled gentle pressure is put on the plates, and the force increased slightly from time to time during a period of twelve or twenty-four hours. The paraffin will now be in a solid cake, the weight of which in grammes will be the percentage proportion yielded by the lubricating oil from which it was obtained. The proportion of lubricating oil to crude oil being known, the amount of paraffin in the crude oil is readily calculated. The paraffin ("paraffin scale") thus obtained is not quite pure, retaining some colouring and odorous matters. By subsequent treatment with sulphuric acid and soda, or recrystallisation from petroleum spirit, it may be obtained colourless and inodorous, but this operation is generally unnecessary of performance by the analyst, as but little by weight is lost in the purification. Its melting-point should, however, always be determined, as the higher this is the more valuable the paraffin. For this purpose a small quantity of the melted paraffin is drawn up into a capillary tube ten or twenty centimetres long and about half a millimetre in diameter, the tube immersed in cold water, and the vessel containing the water heated until the minute cylinder of paraffin changes from the condition of an opaque solid to a transparent liquid. By means of a delicate thermometer placed in the water, the point of change can be determined to the tenth of a Centigrade degree: it varies from 40° to 60° C.

In conclusion I would recommend that in reporting on the oil-value of a coal, etc., the chief products be described respectively only by the terms "spirit," "photogen," "lubricating oil," "paraffin," and "coke," and that the specific gravity, at 15·5° C., and boiling point of each of the liquids, and the melting point of the paraffin be always given. The term "spirit" is already common for this the liquid of lowest boiling point, and is sufficiently indicative of its use as a substitute for spirit of turpentine. "Photogen" is definite as a distinctive name for the burning-oil or "light-producer," and already more restricted in its application than its synonyms "paraffin oil," "lamp oil," "illuminating oil," "heavy naphtha," "solar petroleum," "solar oil," &c. In the International Exhibition of 1862 (see Juries Report, Class II., Section A.) solar oil was in one place described as the coal product, having a specific gravity of 0·833 or 0·835, in another as the product containing no oils of less specific gravity than 0·870 or more than 0·920. Such discrepancies are most confusing, and should be avoided. If the results of the examination of coal, lignite, shale, &c., and petroleum be reported in the manner above indicated, the amount of acid and alkali used and the loss in distillation and in purification being also given, there will not be much difficulty in determining the money value of the raw material, as the cost of erecting and maintaining oil works can now be readily ascertained, and the prices of all materials and products are almost daily published.

17, Bloomsbury Square, London.

‡ Photogen, as usually met with in commerce, does not begin to boil till heated to 170° or 180° C. Some liquids yielded by coals, treated as above described, have a much lower boiling-point and much higher specific gravity. In four recent experiments with common household coals (Silkstone, &c.), which had been carefully distilled at a temperature just below a low red-heat, I obtained products boiling at 115° to 120° C., and having specific gravities of 0·880 to 0·920. They closely resembled the "coal naphtha" of the coal-tar obtained in distilling coal at the high temperatures of gas manufacture. Shales found in the neighbourhood of such coals also often yield naphtha instead of photogen.

PROCEEDINGS OF SOCIETIES.

BRITISH ASSOCIATION, NOTTINGHAM.

Address to the Chemical Section, by H. Bence Jones, *A.M., M.D., F.R.S., President.*

From the foundation of the British Association, in 1831, I believe no practising physician has been President of the Chemical Section; and I cannot take this chair when I know there are so many around me much better qualified than I am to lead and to direct the discussions that will take place on various papers that will be read, without asking your extreme indulgence for my shortcomings when subjects are before you which will be far above the direction of my inquiries.

When, however, I consider that my presence here may be regarded as a slight evidence of the relationship that exists between chemistry and medicine, I am encouraged in my undertaking by the thought, that whatever sets forth the union of chemistry and medicine tends to promote not only the good of science, but also the welfare of mankind.

For centuries this union has been at one time admitted and at another disallowed; but in the last half-century the discovery of Dr. Bright has proved that chemistry is absolutely requisite for the detection of a large class of diseases, and that without chemistry the nature of these diseases cannot be understood.

Moreover, since this great discovery the action of different chemical substances on the different forces in the different living textures, as, for example, in the muscles

and nerves, has been so far investigated by chemists that it is daily becoming more and more certain that not only must every medical man become a chemist if he wishes to have any clear idea of the action of air, food, and medicine, but that the chemist who has most knowledge of the different forces that act in the body will require to learn the forms of matter in which those forces reside, and then with tentative skill he will quickly be able to regulate the qualitative and quantitative errors which constitute disease. In other words, when the union of chemistry and medicine is perfect, then science will show us how to keep or to regain the greatest of blessings, health.

The past year has not for chemistry been a year of great progress, though the harvest of new truths has been quite equal to the average.

That grand field for discovery, the synthesis of organic substances, furnishes as usual the most important fruit; and, as in duty bound, let me first mention the results that have been obtained by Professor Frankland at the Royal Institution.

His synthetical researches on ethers have partly been published in the *Philosophical Transactions*. He has succeeded in replacing all three atoms of hydrogen in the methyl of acetic acid by alcohol radicals; and thus he has obtained a third kind of butyric acid, namely, di-meth-acetic acid,

$$\left\{\begin{matrix}CMe_2H\\COHo,\end{matrix}\right.$$

and a new valerianic acid, namely, tri-meth-acetic acid,

$$\left\{\begin{matrix}CMe_3\\COHo;\end{matrix}\right.$$

also, iso-lauric acid,

$$\left\{\begin{matrix}CAy_2H\\COHo.\end{matrix}\right.$$

The same reaction has also been extended to the replacement of the hydrogen of acetic acid by isopropyl, and an entirely new series of compounds containing this radical has thus been obtained. One of these forms a second new valerianic acid, namely, isopropyl-acetic acid,

$$\left\{\begin{matrix}CPr\beta H_2\\COHo.\end{matrix}\right.$$

The numerous compounds of this beautiful series have not yet all been examined and submitted to analyses, and hence these results are still unpublished.

Taken together, the data furnished by this investigation establish beyond doubt the internal architecture of the fatty acids, placing the constitution of these bodies on as certain a basis as that of the compound ammonias synthetically investigated by Hofmann.

Professor Frankland has also continued his researches with Mr. Duppa on the synthesis of acids of the lactic series.

M. Persoz and Professor Maxwell Simpson have added still further to our knowledge on the synthesis of organic acids; and Professor Hofmann, notwithstanding his engagements in superintending the building of two grand laboratories for the promotion of chemical research, has found time to send us the synthesis of guanidine.

Before leaving this subject of synthetical chemistry, I must mention Professor Roscoe's paper on the "Chemical Intensities of Sunlight," for this is the direction in which the chemist looks for the glorious climax of all his synthetical investigations—the discovery of the chemical architecture of substances in the vegetable world.

The next grand field of investigation, analysis, seems comparatively deserted now. A most remarkable discovery has been made by the Master of the Mint on the absorption and dialytic separation of gases by colloid septa: for example, he finds that mixed gases pass through india-rubber at different rates proportioned to their power of liquefaction. The oxygen of atmospheric air passes through rapidly, whilst the nitrogen is comparatively stopped. The importance of this discovery in metallurgy, and its application to the physiology of respiration and of the passage of oxygen from the blood into the textures must be apparent to all. Mr. Vernon Harcourt has begun to estimate quantitatively the effect of time in influencing the amount of chemical change; or more generally, the laws of connexion between the conditions of a chemical change and its amount. Then we have new researches on gun-cotton, and a new series of hydro-carbons has been extracted from coal-tar. Some further spectrum analyses have been made by Mr. Huggins; among these are the analyses of comets and of the new star in Corona Borealis, of which the author will give you his own account; and, lastly, in physiological chemistry we have an important paper on animal heat, by M. Berthelot, being the third memoir of his researches on thermo-chemistry; and a most valuable work on colouring matters and extractive matters of the urine, by Dr. Schunk; and a paper on the detection of an alkaloid fluorescent substance like quinine in the different structures of the body, by Dr. Dupré and me.

Pardon my egotism if for a moment I dwell on my own subject, when you may consider other subjects are far more deserving of further remarks.

It seems but a few years ago when we were taught that the animal and vegetable kingdoms were composed of entirely different kinds of substances. Nitrogenous compounds were said to belong to the animal kingdom, and the vegetable kingdom was said to be formed of carbonaceous matters only. The ammoniacal products of the gas-works were considered curious; and only from the time of Professor Liebig's investigations do we date our knowledge of the all-pervading presence of albuminous substances in vegetables. We can now see plainly that this was the death-blow to all chemical distinction in the composition of vegetables and animals.

But no wrong knowledge is easily set right. First starch, then woody fibre, then colouring matters like indigo, then alkaloids like quinine were one after the other thought to distinguish the vegetable from the animal creation, and each of these substances or their representatives have at last been found in animals. Even protagon, which was thought to belong only to the nerves of animals, has been found by Hoppe in maize and other cereals to the amount of 0·149 per cent. So that really at the present time no chemical distinction whatever between vegetables and animals can be made; and except in the mode in which these different substances are produced in the two kingdoms of nature, no chemical difference exists.

This is seen in the following two columns of substances, and to each column must now be added protagon:—

Formed synthetically	and	Formed analytically
Oxalic acid		Albumen
Formic ,,		Casein
Lactic ,,		Animal quinoidine
Acetic ,,		Indican
Valerianic ,,		Glycocol
Glycerine		Taurin
Sugar		Leucin
Starch		Urea
Cellulose		Caprylic acid
Cholesterin		Caproic ,,
Butyrin		Capric ,,
Palmatin		Olein
Stearin		Stearin
Olein		Palmatin
Capric acid		Butyrin
Caproic ,,		Cholesterin
Caprylic ,,		Cellulose
Urea		Starch
Leucin		Sugar
Taurin		Glycerine
Glycocol		Valerianic acid
Indican		Acetic ,,
Quinine		Lactic ,,
Casein		Formic ,,
Albumen		Oxalic ,,

Let me for an instant point out to you what a vast field for analytical discovery lies open here to the chemistry of the future.

Various processes of oxidation, hydration, dis-hydration, and splitting, taking place at a temperature below 100° F., produce in animals a multitude of compounds which lie between albumen and carbonate of ammonia. The analytical chemistry of the future will some day be able to form from albumen all these descending compounds, as surely as we are now progressing by synthetical discovery to the formation of all the compounds that are put together by the synthetical chemistry of vegetables; and as the synthetical chemist is already surpassing nature by forming combinations which vegetable life has never yet produced, so the analytical chemist of the future will probably from albumen educe innumerable compounds, which in the tissues and secretions of animals have never been known to occur.

It is the special function of the British Association to popularise science, and to interest the public generally in the discovery of scientific truth. This Association is in fact a means of education. It was intended to promote the diffusion of natural knowledge among the people, because it was considered that that knowledge surpassed all other knowledge in its usefulness and benefit to mankind.

From its relationship to the public, the British Association is more interested than any other society that exists in hastening the time when education in natural knowledge will be at least as general as the education in classical knowledge now is.

My predecessor, Professor Miller, last year told you that "some years will no doubt elapse ere science is admitted to take equal rank as a means of education with the study of classical literature. Still it is but a question of time. The practical instinct of the nation is becoming alive to the necessity of making certain portions of the training of our youth consist in the systematic study of the elementary parts of properly selected branches of science."

Although we may say with Mr. Gladstone that time is on our side; and although we are beginning to ask how our present formula for education has arisen, and why it remains almost unchanged whilst all natural knowledge is advancing; and although an entire change in everything except the highest education has taken place; yet public opinion is affected so slowly, and the prejudices of our earliest years fix themselves so firmly in our minds, and the belief we inherit is so strong, that an education far inferior to that which a Greek or a Roman youth, say twenty centuries ago, would have received, is the only education fit to make an English gentleman, that I consider it is of no use, notwithstanding the power which this Association can bring to bear on the public, to occupy your time with the whole of this vast question.

But there is an outlying portion of this subject which personally touches each one of us here present, and this with much diffidence I venture to bring before this section of the British Association.

I allude to the present state of education in natural knowledge of that portion of the community who may at any moment be asked to tell any of us here present what mechanical means should be used to lessen or increase the mechanical actions of the body, and what chemical substances should be taken to lessen or increase the different chemical actions within us when they rise or fall to such a degree as to constitute disease.

I know well that no expression of opinion can be given collectively by this chemical section on the necessity for a preliminary education in chemistry and physics of those who undertake, first to understand, and then to give advice on the errors of oxidation, digestion, secretion, and nutrition of our bodies; but I may, perhaps, lead you individually to consider this subject, and to bring your influence to bear upon this question as being at the root of a great change, which may bring a direct benefit to us and to our children in helping us to procure and to preserve our health; whilst it will lead to an increase in the number of those who are looked on with great favour by the British Association—I mean the individual cultivators of natural knowledge.

In order that you may see clearly what is wanted, I will contrast the present state of medical education with that reasonable knowledge which I am quite sure every one in this chemical section will say ought to be possessed by those who attempt to understand and to regulate an apparatus that works only whilst oxygen is going into it and carbonic acid is coming out of it.

I will, as shortly as possible, put before you the present education of those who practise medicine.

The present higher education for the medical profession consists, shortly, in learning reading, writing, and arithmetic in the first ten years of life. In the second ten years, Latin, Greek, some mathematics or divinity, and perhaps some modern language. In the third ten years, physics, chemistry, botany, anatomy, physiology, and medicine, and perhaps surgery.

Looking at the final result that is wanted—namely, the attainment of the power of employing the mechanical, chemical, electrical, and other forces in all things around us for increasing or diminishing the mechanical, chemical, and other actions taking place in the different textures of which our bodies are composed, it is quite clear that the second decennial period is passed without our advancing one step towards the object required; and that in the third decennial period the amount to be learned is very far beyond what is possible to be attained in the time allowed.

If we turn to the lower education. In the first eighteen years of life, reading, writing, and arithmetic, and enough Latin to read and write a prescription, constitutes the minimum to be acquired. During the next three years, physics, chemistry, botany, anatomy, physiology, and the practice of medicine, surgery, and midwifery have all to be learned, and from this crowding it follows that the study of physiology is begun at the same time as the study of physics and chemistry. In other words, the structure and the foundations are commenced at the same time. The top of the house may be almost finished when part of the foundations has not been begun.

What chance is there of any one understanding the actions of the chemical, mechanical, and electrical and other forces in the body, until a fundamental knowledge of chemistry, mechanics, and electricity has been first obtained? What chance has a medical man of regulating the forces in the body by giving or withholding motion, food, or medicine with any reasonable prospect of success when a preliminary education in these sciences is thought to be of no importance?

It seems to me that the only possible way to make the present preliminary education for medical men less suited to the present state of our knowledge would be to require them to know Hebrew or Arabic instead of Latin, in order that the origin of some of our words might be better understood, or that prescriptions might be written in one or other of these languages.

Let me now, for contrast sake, draw you a picture of a medical education based upon the smallest amount of classical knowledge and the greatest amount of natural knowledge which can be obtained.

In the first ten or twelve years of life a first-rate education in the most widely used modern language in the world, English, with writing and arithmetic, might be acquired, and in the next five or ten years a sound basis of knowledge of physics, chemistry, and botany, with German or French, might be obtained; and in the following five years anatomy, physiology, and medicine, surgery, and midwifery.

If every medical man were thoroughly well educated in

the English language, and could explain the nature of the disease and the course to be followed in the most idiomatic and unmistakeable English, and if he could use all the forces in nature for the cure or relief of his patient, and if he could, from his knowledge of chemistry and physica and their application to disease and medicine, become the best authority within reach on every question connected with the health and welfare of his neighbours; and if he possessed the power of supervising and directing the druggist in all the analyses and investigations which could be required as to the nature and actions of food, drink, and medicines, and as to the products of disease, surely the position and power and agreement of medical men would be very different from that which they now obtain by learning some Latin and less Greek.

In reference to this subject allow me to read an extract from a letter received from Dr. Acland, Regius Professor of Medicine in the University of Oxford, and therefore no mean authority on the study of classical languages:—

"It was proposed by me that physics should be optional with Greek. The proposal was rejected, and the Council has passed the recommendation that no one shall be allowed to register as a medical student for any department of practice who has not passed in Greek What kind of Greek examination is it to be? Dr. Liddell, Goldwin Smith, Dr. Temple, in vain raised their voices, through me (who was authorised to quote them), as to the mischief of this resolution, if passed. It tends to encourage inaccuracy, to lower classical study, to foster cram, and to deteriorate examinations. It tends to exclude many youths who have a great and special aptitude for physical pursuits and observation from medical study. It is difficult to assign any good reason beyond this, that Greek is part of a gentleman's education, and must therefore be put on the list of study for a liberal profession. It cannot be urged that it is the best preparation for a youth intended for a general practitioner in a country place to prepare a cram, minimum Greek examination. If he were forming thereby accurate habits of thought and of observation, it were otherwise. It cannot be so with all. I look on the decision as a grave one, both for the Council and for the students. If any licensing body or university refuses to adopt the recommendation, I cannot think the Privy Council would disfranchise it."

At present, so far from physicians possessing more knowledge of food and of medicine than any other class of persons in the community, the analytical and pharmaceutical chemists are rapidly increasing in knowledge, which will enable them not only to understand fully the nature and uses of food and medicines, but even to detect the first appearances of a multitude of chemical diseases. Their habits of investigation and their knowledge of the nature of the forces acting in the body will gradually lead them to become advisers in all questions regarding the health of the community, and from this they will, like M. Bouchardat, in Paris, become almost, if not altogether, practitioners of medicine.

No doubt chemists are very far from being medical practitioners at present, but remember that there is no limit to natural knowledge, and that each moment the chemical knowledge of things around us is progressing, and that chemists are becoming able better to answer every question that can arise regarding the air, water, food, drink, and medicine which, by means of the forces that exist in them, act upon the forces within us, and give rise to the phenomena of health and of disease; whilst, as if to lessen the time that might be devoted to acquiring natural knowledge, the authorities who regulate medical education only this last spring have determined that, in addition to Latin, every medical man shall possess a competent knowledge of Greek, in order that the derivation of hard words may be obtained from the brain instead of a dictionary.

In confirmation of my opinion of the direction in which the treatment of disease is progressing, I may just refer to the cattle plague, which in 1745 was treated by Dr. Mortimer, at that time secretary of the Royal Society, and therefore one of the most scientific physicians in the country, with antimony and bleeding. In 1866 two chemists, Dr. Angus Smith, Ph.D., F.R.S., and Mr. Crookes, F.R.S., gave the only useful suggestion for combating the disease, namely, by the arrest or the destruction of the poison by chemical agents.

There is yet another point of view in which chemists will see the harm that results from our present medical education.

The use of Latin in our prescriptions requires that the pharmaceutists should learn at least sufficient Latin to read what we have written. Many errors have arisen, and will arise, from the dispenser being unable to give the directions rightly. To avoid such mistakes a portion of the time that ought to be given to the attainment of the highest possible amount of chemical acquirement, and a perfect knowledge of the English language, or some foreign language, wherein he might learn the discoveries in chemistry, and the improvements in pharmacy of other countries, must be devoted to the learning of Latin in which the physician writes his directions.

All our druggists in England ought to be what they are in Germany and in France, chemists capable of any analysis that might be required of them, and able to satisfy themselves and the medical men that the substances they sell are what they profess to be—pure, unadulterated chemical compounds.

No one of my hearers in this section will consider five years a long time for the acquirement of such knowledge; and until the pharmaceutists all obtain this education, medicine will be subject to a great cause of uncertainty in the variations in the quality and quantity of the different substances which, under the same name, are obtained from different druggists.

Before I conclude, I must apologise to some in this section who may think that this subject is of no interest to them by reminding them that none but chemists can judge what the worth of chemical education really is, and I am sure that no body of scientific men exist who are so fitted to judge of the necessity of an education in natural knowledge for those who employ the forces around us to regulate the forces within us as the chemical section of the British Association.

Last year Professor Miller said, "It behoves all who are themselves engaged in the pursuit of science to consider in what way they can themselves aid in forwarding the cultivation of natural knowledge."

I ask you, for the good of science and for your own good, to exert your influence in the first place, and more especially to effect a change in the preliminary education of all those who intend to practise medicine, so that, leaving Greek and Latin to be the ornaments and exceptions in their education, they may have time to obtain the best possible knowledge of the chemical and physical forces with which they have to deal. I urge this because of my conviction that whenever the most perfect knowledge of chemistry and physics becomes the basis of rational medicine, then, and not till then, medicine will obtain the highest place among all the arts that minister to the welfare and happiness of man.

Ozonogene.—Under this name M. Duplessis has produced an instrument like that in use for the continuous disengagement of hydrogen, but in which nitric oxide is generated by the action of nitric acid on copper turnings. A little of the gas being allowed to escape produces nitrous acid, which acts as a powerful disinfectant. A small instrument for domestic use might be made on the same plan as a Dobereiner's lamp.

ROYAL SCHOOL OF MINES, MUSEUM OF PRACTICAL GEOLOGY.

A Course of Twelve Lectures on Chemical Geology, by Dr. Percy, F.R.S.

Lecture No. VIII.

(Continued from page 81.)

Now let us look at the composition of peat, and let us compare it with the composition of wood, as shown by the analysis I gave you a little while ago. I have taken a series of analyses of peats from various parts of the world, and will give you one or two as samples. Watch the change of composition from woody tissue. I will not give you the result simply of the analysis, because the quantity of ash is variable from the introduction of foreign substances—sand, for instance—into a peat bog. Hence we cannot judge from raw analyses. I will therefore eliminate these accidental constituents, and compute the proportions between the quantities of carbon, hydrogen, and oxygen, and then we shall get the means of exactly comparing these bodies with reference to their composition.

We will take a specimen of Irish peat:—

Carbon	62·18
Hydrogen	6·99
Oxygen and nitrogen . . .	31·03

You see here is a marked difference already between this peat and woody tissue, especially in the relative increase in the carbon and hydrogen. I will show you by and by how you can explain all the transformations completely by the separation of the gas called marsh gas, carbonic acid and water, during the process of natural decay and the formation of peat. We have a specimen of that gas on the table. It is the gas which produces the terrible accidents in coal mines. Carbonic acid is the gas of soda-water—"fixed air." By certain formulæ, with which I will not trouble you in detail, it may be shown that every transformation—every variety of coal fuel we meet with—may be explained easily by the separation of these various gases from woody tissue; and we know that in boggy ground these two gases are evolved—marsh gas and carbonic acid. The gases so evolved may be collected, and after separating the carbonic acid by lime water you get the marsh gas, which is the clear colourless gas contained in this vessel on the table.

Now let us take a careful analysis of the peat of Cashmere:—

Carbon . . .	55·66
Hydrogen . . .	61·12
Oxygen . . .	38·22

I am sorry to trouble you with these numerical details, but really it is impossible to avoid them if we wish to arrive at accurate results. It contains various kinds of organic matter, which have been perfectly investigated, but the results are not of sufficient importance to us for me to occupy your time with them.

I may say, *en passant*, that peat might of course, in the absence of coal, be regarded as a very valuable fuel. Peat differs from coal as containing more hydrogen and carbon, but carbon is the great point. It may be shown that, weight for weight, peat is very greatly inferior in heat-giving power to any of the commonest varieties of coal. While coal is abundant and cheap in this country, it is quite hopeless to bring peat in competition with it. Various attempts, I know, have been made and repeated at intervals to smelt iron by peat in Ireland, but all the attempts that have been made in that direction have hitherto failed, and I believe they will fail, of necessity, until our coal becomes considerably increased in price, or, what is equivalent, much rarer. The price of coal is rising, and rising pretty rapidly, but until it is very much greater than at present, the competition of peat with coal is quite hopeless. Peat is used in some parts of the Continent—in Sweden, for instance—in some processes connected with iron smelting. It succeeds there because labour is very cheap there, and coal does not exist. The labour involved in this employment of peat consists in collecting the peat, submitting it to a grinding operation—like that to which clay is submitted in the making of bricks—forming the peat so prepared into a muddy mass, and then compressing it into bricks. All this is very expensive in point of labour. It may do in Sweden, but it will not do here. In Bavaria, peat is used in locomotive engines.

The next division of our subject is coal, properly so called. Under this term "coal" are included a great variety of bodies, which, both in their external characters and internal constitution, differ immensely from each other. We have, for example, at one extreme, the brown coal. Here is a specimen of it, presenting a distinctly woodlike structure. It is very much like a piece of wood, but yet it is very far removed from wood in composition. It is farther removed from wood than peat is, notwithstanding its appearance. Then, at the other extreme, we get the mineral called anthracite, which occurs in South Wales. It is a shining, lustrous body, which may practically be regarded as carbon. It contains a little oxygen and hydrogen, but it is essentially carbon. I have collected specimens of coal from almost every part of the world, and I shall direct your attention especially to several of these coals, as they present features of particular interest; and much of the information I shall give has not been laid before the public.

You will naturally ask me for a definition of coal. Well, I confess that is one of the most puzzling things I have ever attempted to grapple with. We all know, or fancy we know, what we mean by the term coal—the black, hard stuff which we buy here in London and use for fuel—but what is there essential about coal? How may coal be represented so as to distinguish it from every other body? The construction of an exact definition is the difficulty; I cannot give you one. Many have attempted to define coal, and I believe all have hitherto failed. That is owing to the fact of the different kinds of matter to which the name coal is applied varying so widely, not only in external appearance, but also in chemical composition. You can easily understand, then, the difficulty of constructing a definition to embrace, and embrace only, all these various matters, and to exclude the matters which occur in association with coal—resin, and so forth. Perhaps you have all heard of that famous trial which came off in Edinburgh on that subject, and which was published in a quarto volume containing 250 pages. The suit was to try the definition of coal. Gillespie, the plaintiff, granted a lease of a colliery to Russell, in which it was agreed that the lessee should pay to the lessor sixpence a ton royalty on all the stuff he raised from the pit as coal. In the course of the working a stuff was turned up which was sold at a much higher price than ordinary coal—the Boghead coal or Torbane mineral. One party objected to apply the name "coal" to it because if it could be proved to be coal then it came under the terms of the lease and was subject to the royalty; but inasmuch as a much higher price was obtained for it than for ordinary coal, it occurred to the lessee to dispute the nature of it, and the matter resulted in a trial at law. A very extensive trial it was. Witnesses from all parts of the world were examined—chemists, botanists, geologists, and all sorts of men, and perhaps there were as many on one side as on the other, one scientific man saying it was coal and another saying it was not, as is usual in cases of this kind. Well, the poor jury were utterly bewildered, and they were directed by the Lord Justice to ignore altogether the scientific evidence, and to come to their verdict on a plain consideration of the practical facts of the case. They gave their verdict in favour of the lessor as against the lessee. Well, it is a very curious thing that shortly after the Scotch jury in this particular case had

affirmed this stuff to be coal in the ordinary meaning of the term coal, the Prussian authorities had to discuss the very same question with regard to the duty on the import of this mineral in question, and they determined that it was not coal. There has been another trial, Gillespic *v.* Russell, and the lessor got the victory with heavy damages. I do not know anything more interesting than the study of this wonderful trial, which has been published; and it is not only very instructive, but also very amusing. You find these scientific gentlemen coming forward and giving their evidence most confidently, six on one side and half a dozen on the other, all the way through.

Now, what element shall we take in attempting to construct a definition of the term coal? I am sure we cannot take its chemical constitution purely; shall we take its geological character? Well, possibly there is more hope in that direction, but here is one point in the consideration which you will see will puzzle us directly. As peat may contain a large amount of foreign matter—sandy matter—washed in, so may coal. It may contain a large amount of shale, for instance, which is a variety of clay. You know how some coal contains a large amount of ash, and housekeepers complain of the dusty quality of such coal. Now, the substance called shale is nothing more than clayey matter containing a certain amount of coal universally diffused throughout the mass. On the other hand, that which we acknowledge to be coal contains a certain amount of shaley matter. In one case we may have a shaley mass containing 95 per cent. of clay and 5 per cent. of coal; in the other case, we may have a coal containing 5 per cent. of clay, the rest being carbonaceous matter. Now, between these two extremes we may find every gradation. The one thing we call coal, and the other we call shale, and the one gradually passes into the other. Now, where is the line of demarcation? There is no exact line of demarcation, and hence from this cause alone there is no precise definition possible. The shale is a comparatively useless body. It could not be used as fuel. It was proposed to define as coal only such as could be used as fuel. Then, with regard to the geological aspect, I do not think I can present you with evidence sufficiently conclusive on which to base a definition. In fact, we cannot construct a definition of coal from geological considerations merely. We know perfectly that in coal measures there are fossils associated therewith; but then coal is not confined to those measures. We find coal in the lias; we find coal in the tertiary, and so on; and some of these coals are so identical in every respect with the true coal of the coal measures that it is impossible to distinguish one from the other. I have tried a definition of coal, but it is not as satisfactory as I could wish. It is this: "Coal is a solid mineral substance, more or less easily combustible; varying in colour from brown to black; opaque, except in very thin slices; brittle; not fusible without decomposition not sensibly soluble in such solvents as dissolve resins, as ether, benzol, chloroform, and turpentine; and not containing sufficient earthy matter to prevent its being applied as a source of heat." You see how vague our terms must be with regard to the combustibility of coal. In its brittleness, too, there is great variety. So far as I know, coal is not fusible without decomposition. This is a very important element in the definition. If we take certain coals and expose them to heat in close vessels, the coal softens, and if we continue the heat, the coal will come out as coke. The particles adhere, and we get that form, but in the softening there has been decomposition to some extent. There is no fusion of coal like that of a piece of beeswax: it is a totally different thing. I have mentioned that coal is insoluble in four solvents which dissolve resinous bodies. It is true that a small quantity of coal may be extracted from coal by these solvents, but still the coal itself is insoluble. I am careful to mention this, because sometimes we find associated with coal in large quantity, as in the New Zealand coal, resinous matters which do dissolve in these menstruums. We might, I think, probably, speak of stratification, sedimentary origin, and so on, in connexion with coal. Dr. Playfair suggests that, but I am not quite certain about that point, because we find some coal which is conceived to be formed by the sublimation of certain bodies which have percolated through shale and schist and converted them into coaly matter.

In order more exactly to compare the constitution of wood and the various matters derived from it under the names of peat and coal, I have drawn up a short table in which I have uniformly calculated the carbon at 100. This is in order to enable you to see the relative change in the composition of coal as we proceed from woody tissue towards anthracite. These quantities are the mean of many analyses.

	Carbon.	Hydrogen.	Oxygen.
Wood	100	12·18	83·07
Peat	100	9·85	55·67
Brown coal or lignite .	100	8·37	42·42
Non-caking coal . .	100	6·12	21·23
Steam coal from the Tyne	100	5·91	18·32
Semi-anthracitic coal from South Wales	100	4·75	5·28
Pennsylvanian anthracite	100	2·84	1·74

You see what a large quantity of oxygen, relatively, has passed off from the woody tissue, even in its transformation into peat. The brown coal, as the Germans call it, or lignite, is the coal nearest approaching wood in composition. There is a relative increase in the proportion of carbon all the way through the table. The points to keep in view are the relative increase in the proportion of carbon and the relative decrease in the proportion of oxygen. The non-caking coal is represented by the coals of South Staffordshire, Derbyshire, Yorkshire, and Scotland. These are not coals we use to burn in London. You know when we put the sea coal on a fire—Newcastle coal, for instance—the pieces form a lump, and we have to break them up. The semi-anthracitic coal, as it is termed, is well adapted for steam navigation. The Pennsylvanian coal I have given is a very fine specimen I obtained from Sir Charles Lyell, and analysed many years ago.

Now, beginning with wood, and just eliminating gradually as we go on, and as Nature has done in her process of decay, those three compounds, carbonic acid, marsh gas, and water, we are enabled to explain in the simplest and most rational way the formation of every variety of peat and coaly matter from wood.

Before I conclude I will draw your attention to a specimen of this marsh gas, which I have placed before you. This fiery stuff is produced by a chemical process known in the laboratory. This is the gas which, mixed with air, has proved so terribly disastrous in coal mines. When mixed with oxygen it is highly explosive. This gas is contained in coal pretty much in the same way—at least in some cases—as air is contained in charcoal. I have many times heard the gas issuing from the coal when a new piece of coal is opened in a pit. It diffuses itself, and when you draw up your safety lamp into the gas, the gas enters the lamp, and the flame elongates. It is interesting to watch this effect. This gas causes loss of life to about one thousand persons annually, besides maiming many others.

In our next lecture we will conclude the subject of coal.

ACADEMY OF SCIENCES.

August 20.

M. Stanislas Meunier gave an account of "*A Compound of Oxide of Cadmium and Potash.*" In a former communication the author had mentioned that oxide of cadmium dissolves freely in potash and soda in a state of fusion, and had expressed an opinion that a definite cadmiate of potash was formed under the circumstances. He now describes

a method of separating what he believes to be such a compound. Fused potash is saturated with oxide of cadmium, and while the mixture is kept in a state of fusion a cold solution of potash is carefully added. After each addition of the solution a white precipitate forms which redissolves, but after a time this precipitate becomes permanent. When this happens the author stops the process and allows the mixture to cool slowly. It thus becomes a crystalline mass, but at the bottom some of the white precipitate is found. The crystals do not entirely dissolve in water. The liquid is seen to be full of pearly shining scales, which, when collected, are found to be quite insoluble in water and to be rich in oxide of cadmium. They are, in fact, according to the author, hydrated cadmiate of potash, but he has not yet obtained them in sufficient quantity to analyse. The compound is hydrated, he says, for a prolonged boiling with a solution of potash decomposes it and causes a deposition of oxide of cadmium; it contains cadmic oxide combined with potash, for acids cause the disappearance of the scales and produce amorphous hydrate of oxide of cadmium soluble in an excess of the acid.

M. Monthier presented a note "*On three new Hydro-electric Piles.*" In the first the author uses sulphuric acid and iron. In a cylindrical vessel of iron he places a prism of carbon, and then pours in diluted sulphuric acid. The carbon and iron form the two poles. Two of such batteries are sufficient to cause the ordinary bell to ring. The batteries are said to be cheap, inasmuch as the sulphate of iron produced may be used in another system, composed as follows:—In a cylindrical vessel containing a concentrated solution of protosulphate of iron the author places a cylinder of zinc and a prism of carbon, forming the two electrodes of the pile. The zinc dissolves, hydrogen is disengaged, and hydrated sesquioxide of iron precipitated. Two elements of this kind served for an electric bell for several months. Thirdly, we have described a battery which we believe to be entirely novel, cheap, and nasty. In a pile composed as the last mentioned, the author employs putrid human urine in the place of the ferrous solution. According to M. Monthier, this last battery is rather stronger than the former.

M. C. Davaine presented another note "*On the Rotting of Fruits and other parts of Living Vegetables*," in which he showed that the fungi mentioned in the previous paper would set up changes in the roots, leaves, and branches of some plants, similar to those fruits undergo. The paper will have some interest for vegetable physiologists.

M. A. Bertin presented a note "*On the Constitution of Glacier Ice.*" The author has examined glacier ice by polarised light. He has found that the superficial part of the higher glaciers is composed of agglomerated snow; but lower down, where the water has sunk into the fissures and become frozen, traces of crystallisation and true ice are found.

NOTICES OF BOOKS.

Journal für praktische Chemie. Nos. 10 and 11. 1866.

The first of these numbers contains two papers by Schönbein. In the first, entitled "*A Contribution to a closer Knowledge of Peroxide of Hydrogen*," the author states that a solution of the peroxide may be concentrated by boiling, and almost completely dehydrated by evaporation over sulphuric acid and under an air-pump at the ordinary temperature. He tells us also that white filter paper drenched with a solution containing only one-half per cent. HO_2, and dried at the ordinary temperature, will give the reactions of the peroxide. Thus, a strip of such paper touched with acetate of lead is soon coloured brownish yellow; touched with a mixed solution of ferridcyanide of potassium and a persalt of iron, it is quickly coloured blue; touched with dilute mixture of ferrous sulphate and iodide of potassium with starch, it is instantaneously coloured the deepest blue; it is also coloured blue by a dilute chromic acid solution containing SO_3; indigo tincture is first blued, and then, when touched with ferrous sulphate solution, is quickly decolorised. Paper dipped in the solution of the peroxide may be kept in a closed bottle, but if left exposed to the air loses the HO_2. The author has also remarked that a strip of such paper enclosed in a bottle containing strongly ozonised air, for a few hours ceased to give the reactions of HO_2, while the end left out of the bottle continued to give them, showing that the peroxide of hydrogen is destroyed—that is, converted into water by the ozone. Although water is so much more easily volatilised than the peroxide, the author shows that the latter is volatile. A strip of paper previously dried over sulphuric acid, and then suspended in a bottle, the bottom of which is covered with water containing only $\frac{1}{200}$ HO_2, will, after an hour, give the reactions of the peroxide with ferrous sulphate, iodide of potassium, and starch. An easy method here given of producing a small amount of peroxide of hydrogen, sufficient, however, for these experiments, we have already published, but may mention again. It is only necessary to shake a few amalgamated zinc turnings with a little in a bottle containing oxygen or even atmospheric air. After shaking for a minute the water will show the presence of the peroxide. Of the next paper, "*On the Action of Platinum, Rathenium, Rhodium, and Iridium on Chlorine Water, an Aqueous Solution of a Hypochlorite, Peroxide of Hydrogen, and Ozonised Oxygen*," we have already given an abstract. Dr. Hoffman's paper "*On the Synthesis of Guanidine*," follows, and then we have the description of "*An Improved Process for the Preparation of Diazoamidobenzol*," by Dr. Martius. The author takes dry and perfectly neutral crystallised hydrochlorate of aniline, and adds to it very gradually, with continual stirring, a cold and faintly alkaline solution of nitrite of soda. The solution should have the specific gravity 1·5, and ought not to contain more than one-half per cent. free alkali and no carbonate. It must also be cooled to $+5^\circ$ C. A lively reaction soon ensues; the crystals of hydrochlorate of aniline become coloured with a yellow layer of diazoamidobenzol; and soon the whole becomes a thick, homogeneous, lemon-yellow-coloured paste. When this point is reached, a little more of the nitrite solution is added to make the paste more fluid, and it is then transferred to a cloth, washed with cold water, and lastly the diazoamidobenzol is freed from the remaining mother liquor by pressure. If this operation is carefully performed with pure materials, the whole of the aniline, it is said, will be converted.

We give the titles of the more important remaining papers and abstracts. "*On the Relations of Isopropyl-alcohol to Propylglycol and Glycerine*," an abstract of a paper by Linneman; "*On Bromide of Benzylidene, and two Hydrocarbons derived therefrom*," by Michaelson and Lippmann; "*On some Amides of the Tolnyl Series.;*" "*On Sulphur holding Derivatives of Toluol;*" "*On Orcin;*" "*On Bromangelica Acid;*" "*On Quinine and Quinidine.*" The last-mentioned is an abstract of a paper by O. Hesse, describing several salts of these bases.

No. 11 is almost entirely occupied with papers already noticed in our columns. The only original article is by Dr. Werner Schmid "*On the Action of Peroxide of Manganese on Solutions of Cuprous Salts.*" The author finds that an excess of freshly precipitated peroxide of manganese left in contact with a solution of sulphate of copper displaces the latter metal, causing a precipitate of CuO_2, and giving a solution of sulphate of manganese. Repeated quantitative determinations showed that exactly an equivalent of CuO and one equivalent of MnO_2 took part in the reaction. The result confirms Schönbein's opinion that peroxide of manganese is an antozonide. Whether peroxide of copper is an ozonide or not is not yet known.

The titles of other papers are as follows:—"*On Franklinite and Thomsonite*," by F. v. Kobell; "*On the Solubility of Isomorphous Salts and Mixtures of them*," by Carl Ritter v. Hauer; "*On the Dimorphism of Antimonious and Arsenious Acids*," by H. Debray; "*On the Chlorides of Wolfram*," by the same author; "*On some Resins, and the Products formed from them by Fusion with Alkalies*," by Hlasiwetz and Barth; "*On Dichlorglycid and its Transformation into Allylen;*" "*On Hydantoinic Acid and Allantrin;*" and "*On the Cyanides of Aromatic Aldehydes.*" The papers the titles of which we have omitted have appeared in our pages either at length or in full abstract.

NOTICES OF PATENTS.

3345. *Improvements in Treating Hydrocarbon Oils.* James Young, Jun., Limefield. December 27, 1865.

This looks like a very valuable invention. The patentee submits the heavier hydrocarbon oils to distillation under pressure, and finds that thereby the heavy oils originally operated upon are converted into oils of lower specific gravity, possessing a higher commercial value. The process may be carried on in ordinary steam boilers (not tubular), which should be proved to 100 lbs.; but it is not found necessary to operate much beyond a pressure of 20 lbs. to the inch. The means of regulating the escape of, and condensing, the vapour can be easily imagined. The operation may be carried on with the crude products of the original distillation, or the lighter oils may first be separated by an ordinary rectification, and only the heavy oils submitted to this treatment.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

1892. R. Hooper, Bradford, near Manchester, "Certain improvements in furnaces."—July 21, 1866.

MISCELLANEOUS.

Excise Prosecutions against Druggists.—On Monday, at the Guildhall, York, before the Lord Mayor Mr. G. Wilson, and Mr. W. D. Husband, informations were preferred by the Board of Inland Revenue against Mr. Knowles, Mr. T. Cooper, Mr. Johnson, Mrs. Spurr, Mr. G. Brown, and Mr. Jacob Wood, all druggists residing in the city, and the charge was that they had sold methylated spirit without a licence. The magistrates convicted Knowles, Cooper, Johnson, Spurr, and Wood, but, in consideration of what they thought was their intention, they remitted the penalty to one-fourth, besides recommending the whole of the cases to the consideration of the Board in London. They were not unanimous in convicting Mr. Brown, and they thought the case against him should have been withdrawn. In this case they should strongly recommend that the whole of the penalty should be remitted.

The City Pumps.—Dr. Letheby has made a special report to the Commissioners of Sewers on the City pumps and their possible influence on the health of the inhabitants. It seems that the water from most of them is derived from shallow wells which receive the soakage from adjoining drains and sewers. In some cases the saline constituents of the water indicate at once the source and nature of the pollution. Thus the water from the well in Leadenhall market, where large quantities of hides are salted on the public way, contains 40 grains of common salt per gallon. The wells in churchyards are strongly tainted with nitrates of potash and ammonia. In all a large amount of organic matter is present. Dr. Letheby, therefore, recommends that the water furnished by the pumps should not be used for domestic purposes.

The Sodium Process in Nova Scotia.—The following extract of a letter from a correspondent in Nova Scotia will interest some of our readers:—"The experiments which I carried out with Dr. K. at the Lake Major Gold Mines proved so satisfactory that Dr. K. was induced to operate upon a quantity of pyrites, which has hitherto been accumulating as waste matter in enormous quantities about the works, as you are aware. This morning he informed me that he has, by the sodium process, and in a very simple and inexpensive way, obtained gold from the pyrites in the proportion of *five ounces per ton*. This result far exceeded his most sanguine expectations. He is desirous of making arrangements for having large quantities of amalgam, and would like to know what it would cost in quantities of a ton."

British Association. — Section B. — Chemical Science.—The following are the titles of all the papers read in the Chemical Section. Most of them will be given in this and future numbers of the Chemical News:—

"*Preliminary Report on the Chemical Nature of Cast Iron*"—A. Matthiesen.

"*On a Phosphatic Deposit in the Lower Green Sand of Bedfordshire*"—J. F. Walker.

"*On a Proposed Use of Fluorine in the Manufacture of Soda*"—Walter Weldon.

"*On the Assay of Coal, &c., for Crude Paraffin Oil*"—John Attfield.

"*On the Poisonous Nature of Crude Paraffin Oil, and the Products of its Rectification upon Fish*"—Stevenson Macadam.

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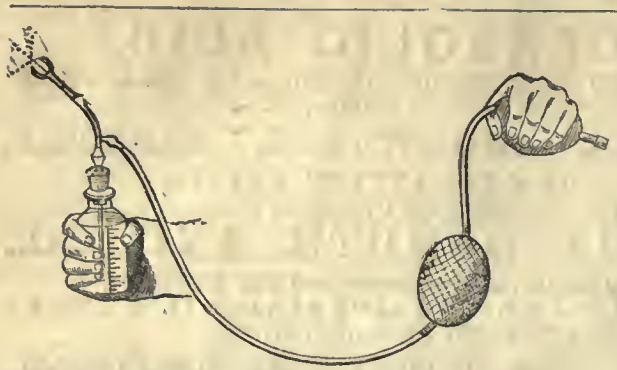

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On the Sources of the Fat of the Animal Body, by J. B. Lawes, *F.R.S., F.C.S., and Dr.* J. H. Gilbert, *F.R.S., F.C.S.**

In 1842 Baron Liebig had concluded that the fat of Herbivora must be derived in great part from the carbohydrates of their food, but might also be produced from nitrogenous compounds. Dumas and Boussingault at first opposed this view; but subsequently the experiments of Dumas and Milne-Edwards with bees, of Persoz with geese, of Boussingault with pigs and ducks, and of the authors with pigs, had been held to be quite confirmatory of Liebig's view—at any rate, as far as the carbohydrates were concerned. But at the Bath meeting of the British Association in 1864, Dr. Hayden expressed doubt on the point, and at the Congress of Agricultural Chemists held at Munich last year Professor Voit, from the results of experiments with dogs fed on flesh, maintained that fat must have been produced from the nitrogenous constituents of the food, and that these were probably the chief, if not the only, source of the fat even of Herbivora. Baron Liebig disputed this conclusion, and his son, Hermann v. Liebig, had since sought to show its fallacy by reference to experiments with cows.

The authors agreed with the conclusions of these latter authorities, but pointed out the inadequacy of the data relied upon by Hermann v. Liebig. They showed that, owing to the much less proportion of alimentary organs and contents, the higher character of the food, the much larger amount of fat produced both in relation to a given weight of animal within a given time and to the amount of food consumed, the much less proportion of the solid matter of the food that passed off in the solid and liquid excretions, and finally the larger proportion of fat in the increase, results obtained with pigs must be much more conclusive than those with either cows, oxen, or sheep.

Numerous tables were exhibited showing the results which had been obtained by the authors in experiments with pigs, from which the following conclusions were drawn:—1. That certainly a large proportion of the fat of the Herbivora fattened for human food must be derived from other substances than fat in the food; 2. That when fed on the most appropriate fattening food, much of the stored-up fat must be produced from the carbohydrates; 3. That the nitrogenous constituents may also serve as a source of fat, more especially in defect of a liberal supply of the non-nitrogenous ones.

* British Association, Nottingham—Section B. August 27, 1866.

TECHNICAL CHEMISTRY.

The Preparation of Sulphocyanide of Potassium, by James F. Babcock, *Boston.*

The usual process for the preparation of this salt, as given by Fresenius, is as follows:—

"Mix together 46 parts anhydrous ferrocyanide of potassium, 17 parts of carbonate of potassa, and 32 parts of sulphur; introduce the mixture into an iron pan provided with a lid, and fuse over a gentle fire. Maintain the same temperature until the swelling of the mass which ensues at first has completely subsided, and given place to a state of tranquil and clear fusion; increase the temperature now towards the end of the operation, to faint redness, in order to decompose the hyposulphite of potassa which has been formed in the process. Remove the half-refrigerated and still soft mass from the pan, crush it, and boil repeatedly with alcohol of from 80 to 90 per cent.

"Upon cooling, part of the sulphocyanide of potassium will separate in colourless crystals; to obtain the remainder, distil the alcohol from the mother liquor."—*Fresenius' Qual. Analysis, 6th ed., p. 57.*

Those who have attempted this process may have been disappointed in not obtaining so large an amount of sulphocyanide as they were led to expect. The process is, when best conducted, far from economical.

The management of the heat is difficult, as well as the exclusion of the air; and the subsequent boiling "repeatedly with alcohol of from 80 to 90 per cent." is of course expensive.

Moreover, the slimy mass left after the solution has been made retards, and in some cases almost totally prevents, the filtration of the liquid, while it has been the writer's experience to find it extremely difficult by this process to get rid entirely of the sulphide of potassium formed, the presence of which unfits the sulphocyanide for the ordinary uses to which it is applied. Repeated failures by this and other methods in use, as the "bisulphide of carbon and ammonia process" (London *Pharm. Journ.*, vol. vii., No. 4), which is certainly disagreeable, and not entirely free from the objections mentioned above, and the want of a process really economical, led to experiments, the result of which is the following method, which has been found uniformly

to give good results, a large yield, and to require far less alcohol than any other process known to the writer.

The saving in alcohol, where the quantity prepared is large, is of course of considerable importance.

The process is as follows:—

Take of cyanide of potassium, in small pieces of about the size of a pea, two parts by weight; sulphur one part.

Mix thoroughly, and fuse gently in an iron pan over a Bunsen's burner, until the cyanide is entirely fused and mixed with the melted sulphur, and the blue flame of sulphur, and the scintillation caused by the burning of minute particles of iron, have ceased; and allow the whole to cool, until a drop let fall into water no longer produces a hissing sound.

Then pour the still soft mass into three parts of water, in which it immediately dissolves; filter, to separate impurities, particles of sulphuret of iron, &c. The filtrate contains a large amount of sulphocyanide of potassium, mixed with sulphide, hyposulphite, cyanate, &c.; the next step is for the removal of these.

This is simply and perfectly attained by the addition, with constant stirring, of dilute sulphuric acid (1 to 4), until the reaction is slightly acid. This operation should be performed under a hood, or in some place where the gases evolved may be removed.

Sulphocyanide of potassium is neutral to test-paper, and not affected by dilute suphuric acid in the cold, while all the other substances mentioned above are at once decomposed, evolving sulphuretted hydrogen and cyanogen compounds, and depositing a considerable amount of sulphur.

The liquid is filtered to separate this, and then contains only sulphocyanide of potassium and sulphate of potassa; the quantity of the latter depends upon the purity of the cyanide of potassium employed, since any carbonate present forms direct sulphur compounds, which are afterwards decomposed by the sulphuric acid added. Where the amount of sulphate formed is large, it may partially separate with the sulphur, as a dirty white crystalline powder.

The filtered liquid is evaporated to one-third its bulk, and allowed to cool, to deposit a quantity of sulphate of potassa. It is then mixed with its own volume of alcohol of about 90 per cent., which causes the precipitation of almost the whole of the sulphate of potassa (*Anthon, J. Pr. Ch.*, vol. xiv., p. 25).

The solution after filtration may be evaporated to dryness, and yields a product containing only a trace of sulphate of potassa, and of sufficient purity, without further crystallisation, for any of the purposes for which it is required—whether as a reagent (iron test), the precipitation of sulphocyanide of mercury for "Pharaoh's Serpents," or the preparation of the ammonium salt for photography. Subsequent crystallisation from alcohol yields the salt perfectly pure.

The commercial cyanide of potassium, being very impure from carbonate and cyanate of potassa, is not so well adapted for use in this process as that known as "granular cyanide;" the increased price of the latter being more than compensated by the larger yield and improved quality of the product. Good commercial cyanide gives, however, very good results.

The heat required is not great, and the vessel should be removed from the fire as soon as possible after the formation of the sulphocyanide, as it rapidly decomposes at a temperature of fusion in contact with the air. This process gives equally satisfactory results, whether small or large quantities are operated upon, and has been perfectly successful in the hands of the writer in the preparation of quantities varying from two ounces to twenty-five pounds. The amount of sulphocyanide obtained is, with good cyanide of potassium, about equal to the weight of the latter employed.—*American Journal of Pharmacy.*

PHARMACY, TOXICOLOGY, &c.

On the Poisonous Nature of Crude Paraffin Oil and the Products of its Rectification upon Fish, by Dr. Stevenson Macadam, *F.R.S.E.**

The great extension of paraffin oil works, both crude and refined, during the last few years, has led to attention being directed to the nature of the discharges which emanate from such, more especially to those matters which find their way into rivers which form the natural drainage of the district. The deleterious nature of these discharges has manifested itself already in the total destruction of all fish in more than one of our Scottish streams, and in the impregnation of the water with paraffin oil and the products of its rectification to such an extent as to impart the characteristic taste and odour of paraffin to the water, and render it unsuitable for domestic purposes. I have had occasion to make a large number of experiments on such discharges, taken alone and diluted with much water, with the view of testing the destructive nature of these liquids and mixtures upon the life of fish, and the general results of the inquiry I propose to lay before the Section. The discharges from the paraffin oil works are of the following nature:—1. Crude petroleum and shale oil escaping from the crude oil casks, either when full or when empty, when the drainings leak away into the surrounding soil, and thence to the drains. 2. The condensing water from the worms of the crude and refining stills, which often passes away impregnated with paraffin oil. 3. The spent acid liquor which has been used in acting upon the crude petroleum or shale oil. 4. The spent alkaline liquid or soda which has been employed in acting upon the oil which has been previously treated with acid. Besides these there is the accidental overflow of the retorts both during the first redistillation of the crude oil, and subsequently in the distillation of the refined oil, and which can hardly be altogether provided against. The drainings from the oil casks, when the latter have been emptied and are exposed to the sun, are considerable when a number of casks are stored together, and the oil which percolates through the soil is liable not only to ooze through the ground, but when rain falls, the oil floats thereupon, and is thus carried into the ordinary drains. Any material damage to rivers, however, from this cause may be lessened by providing proper surface drains, which carry all the oily water to traps where it settles, and the oil may be removed from the surface whilst the water is run off underneath. The condensing water from the stills is liable to be impregnated with paraffin oil from the leakage of the pipes, which is greater when the pipes are of cast iron than when they are constructed of malleable iron. Of course, any excessive leakage is quickly arrested, but there is generally that taint communicated to the water which, independent of the lesser proportion of oxygen dissolved in the water, as compared with ordinary river water, renders the water more or less deleterious to the health of fish. The spent acid liquor and the spent soda liquor, however, are the most serious discharges which

* Read at the Meeting of the British Association.

either regularly or occasionally escape from paraffin oil works, and their influence upon the health and life of fish is much more decided than the paraffin oil itself. The spent acid liquor consists of the sulphuric acid which has been added to the crude oil, accompanied by tar products, including picoline and other basic oils, and to which the acid liquor no doubt owes part of its poisonous properties. Whilst now the material in question is to some extent utilised by separating the tar, and either mixing it with spent oak bark or saw-dust, and using it as a fuel, or by distilling it into pitch, yet occasionally this acid liquor is discharged into a neighbouring stream. It is a black tarry liquid, of the consistence of molasses, with a somewhat sulphurous odour, and a very small quantity added to water confers upon the latter poisonous properties. In one instance, I found this spent acid liquor which was collected, somewhat diluted with water, to possess the following powerful effects upon fish:—1. When the liquor was taken by itself, and fish immersed therein, they were dead in five minutes. 2. When the liquor was diluted with three times its volume of good stream water, and fish introduced into the mixture, they were killed in ten minutes. 3. With one of the liquid and twenty of water the fish died in fifteen minutes. 4. One of the liquor and 100 of water killed the fish in fifteen to twenty minutes. 5. One of the liquid and 1000 of water was poisonous to the fish in two hours; whilst in one of the liquor to 10,000 of water, the fish were not killed by their immersion in the mixed liquid for twenty-four hours, but were apparently sick and prostrate. The spent soda liquor which has been employed in treating the oil which had been previously acted upon by acid, is necessarily decidedly alkaline and caustic in its nature. It has extracted from the oil, and retains in solution, more or less carbolic acid and its homologues, and the poisonous nature of the spent soda liquor is doubtless materially augmented by the presence of these acids. One sample of this soda liquor which was flowing from a paraffin oil work, and which contained extra water, proved destructive to fish in ten minutes; diluted with three parts of water, it killed fish in twenty minutes; with twenty of water, the fish were dead in twenty-five minutes; with 100 of water, the fish were killed in thirty minutes; diluted with 1000 times its volume of water, the soda liquor was destructive to fish in twenty hours; whilst in 10,000 parts of water the fish were not killed, but were apparently slightly sick. Experiments were also made with crude shale oil and the refined oils obtained therefrom, and with Pennsylvanian petroleum and the refined oils extracted from it:—The crude shale oil was destructive to fish when taken in the proportion of one of the oil to 1000 of water; the crude oil being more energetic in its action than any of the others, then in succession the lubricating oil, the burning oil, and the lighter spirit.

The Pennsylvanian petroleum was not so powerful in its poisonous properties as the shale oil employed in the experiments. The crude shale oil, in the proportion of one to 1000 of water, was poisonous to fish in twelve hours, whilst the crude Pennsylvanian oil, in the same proportion, did not kill the fish for twenty-four hours. The refined oils acted in a corresponding manner on fish; thus the refined shale oil, in the proportion of one to 1000 of water, killed the fish in twenty-four hours, whilst the refined Pennsylvanian oil did not prove destructive till two days. The importance of this subject will probably soon be greater than what it is at present, as the manufacture of crude paraffin oil, in conjunction with gas, has already been introduced into one of our gas works in Scotland. The coal used is the Newbattle gas or cannel coal, which yields, when distilled in ordinary gas retorts, at a bright cherry-red heat, about 11,000 cubic feet of gas, with an illuminating or photogenic power of thirty-four standard sperm candles for every five cubic feet of oil gas burned during every hour. When distilled, however, at a low or black red heat, in larger retorts, as carried on in ordinary paraffin oil works, the coal yields only 3000 to 3500 cubic feet of illuminating gas, with the photogenic power of thirty candles for every five cubic feet burned during the hour, so that two-thirds of the total quantity of gas capable of being yielded by the coal is sacrificed; but in place thereof there are obtained about sixty gallons of crude paraffin oil, with a specific gravity of ·900 to ·905. The gas works in question are virtually crude paraffin oil works, in which the gas is utilised, and as the change in the mode of working the coal appears to be profitable, there is every reason to consider it likely that other gas works will follow the example, and become virtually crude paraffin oil works, with refineries attached thereto.

Chlorate of Quinine,*

by CHARLES R. C. TICHBORNE, *F.C.S.*, *&c.*†

WE have determined upon bringing before the British Pharmaceutical Conference a *résumé* of our experiments upon what promises to be one of the most useful of the quinine salts.

The chlorates and perchlorates of the organic bases have not been so far much investigated, although some of them seem stable compounds, easily crystallised, and are, many of them, of great beauty.

Composition.—This point was determined (as regards the neutral salt) by the estimation of each component—each serving as a check upon the other.

The results may be formulated as follows:—

$$4(C_{20}H_{24}N_2O_2,HClO_3)7H_2O.$$

The centesimal composition being—

		Theory.	Practice.
Quinine . . .		73·65	73·9
$HClO_3$	H. . .	·23	
	Cl. . .	8·07	8·04
	O. . .	10·90	10·53
HO		7·15	7·18
		100·00	

The above analysis was made of the salt after drying twenty-four hours over sulphuric acid or well-dried in the air. On continuing the drying over sulphuric acid, it gradually lost nearly the whole of the water. The loss of water at 100° C. was constant.

The quinine was estimated by Professor Jelletts, with the aid of his saccharometer. We may remark that the accurate estimation of quinine can only be accomplished in the above manner, or by the combustion of the carbon—it having been lately pointed out that even the determination of the nitrogen cannot be relied on.

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* Chlorate of quinine was made at the request of Dr. Lyons for some experiments, performed at the Whitworth Hospital, Dublin, in connexion with two or three cases of "Black Death." It has since been employed by that gentleman with great success as a new febrifuge. *Vide* Dr. Lyons' Clinique, *Medical Press and Circular*, vol. i., p. 653. In its therapeutical effects, it must be borne in mind that the particular advantage that it possesses over the other salts of quinine is supposed to arise from the fact that over 10 per cent. of the salt assimilated is available oxygen, and that, from the fact of its being a chlorate of an organic base, it will be a more probable yielder of oxygen to the system than such a salt as chlorate of potassium.

† Read at the meeting of the Pharmaceutical Conference

Chemical and Physical Properties.—Chlorate of quinine presents many of the characteristics of the alkaline chlorates, only in a less marked degree. When pure, it crystallises from a watery solution, in small mushroom-shaped masses, which, on examination, are found to consist of filiform snowy-white crystals. Some chemical salts and many well-known minerals are found to take this character. They present the appearance of an amorphous mamillated exterior, perfectly devoid of crystalline structure, yet, when broken through, are found to consist of exquisite geometrical forms, which are produced by needles or prisms radiating from some axis or point towards the amorphous circumference. The beautiful and well-known mineral wavellite may be cited as a specimen of this characteristic crystallisation. Many of the quinine salts present the same peculiarity, and none more so than the chlorate. When a boiling solution of pure chlorate of quinine is allowed to cool, the solution becomes quite milky, not, as might at first be supposed, from a deposition of minute crystals, but, as the microscope shows, by the deposition of the salt in the form of oily globules, which, on cooling, become vitreous balls, then in a short time change to fine filiform masses of crystals. In this form the salt is again deposited upon the outside periphery of the mass, in an amorphous condition; but at the same time becoming crystalline in the interior as the process continues. A slide from which micro-photographs were procured, by Mr. J. Woodworth, was produced by allowing the solution of chlorate of quinine to cool slowly upon the glass, and when the globules were sufficiently collected to dry rapidly under the receiver of an air pump; by this means the chlorate was retained in its vitreous condition, otherwise it became crystallised. The globules seemed to arrange themselves in a symmetrical form, so much so as to produce a rather pretty microscopic object, each large globule being surrounded by a series of small beads. The vitreous quinine does not polarise, whilst the crystalline does. When the amorphous salt is once dried, it retains that character permanently, but on submerging it in a cold saturated solution of the salt, it very slowly and imperfectly regains its crystalline form.

When the mushroom-shaped masses are broken up, they resemble the ordinary salts of quinine in appearance.

The chlorate crystallises readily from spirit, in which it is very soluble; the solution gives a salt retaining the same number of atoms of water of hydration. Heated gently upon a spatula, it gradually melts, and, after a little time, goes off with a vivid combustion, which sometimes amounts to explosive violence. The combustion is generally attended with a cloud of carbon, a carbonaceous residue being also left upon the spatula. Treated with hydrochloric acid and gently warmed, it evolves chlorine. On adding ammonia in excess to this mixture, a green colour is developed. It is very soluble in boiling water, and soluble in 78·5 parts of cold (15·5° C.). It is also very soluble in water acidulated with the stronger acids, including perchloric.‡

It crystallises much more readily from its solution if it is impure—viz., if it contains a trace of sulphate or hydrochlorate, the crystals in each case retaining the character of the impurity.

‡ For the internal administration of this salt, it is soluble enough in water (probably the most efficacious method of exhibiting it). It is incompatible with the mineral acids, as they form the ordinary salts of quinine: it is for this reason that Dr. Lyons has hitherto prescribed it in conjunction with perchloric acid, itself a valuable oxidiser.

Tests.—Chlorate of quinine, when dissolved in water and acidulated with nitric acid, should give no precipitate with chloride of barium, and none, or only a faint opalescence with nitrate of silver. It should give no precipitate with diluted sulphuric acid, the ordinary tests for quinine being applicable to the base. It is always necessary to ignite a portion, which should leave no appreciable residue. A sample of the so-called chloride of quinine submitted to us consisted of chlorate of potassium and sulphate of quinine.

Process for making Chlorate of Quinine.—The following process and precautions have been adopted by the writer in the manufacture of this preparation:—310 grains of chlorate of barium are dissolved in a small quantity of boiling water, 2 ounces of Howard's sulphate of quinine are mixed with about 12 ounces of hot water, at a temperature of about 90° C., in a porcelain dish. Double decomposition takes place immediately on mixing the two solutions.

$$2(2C_{20}H_{24}N_2O_2,H_2SO_4)15H_2O + 2(2BaClO_3,H_2O) - 10H_2O = 4C_{20}H_{24}N_2O_2,HClO_3)7H_2O + 2Ba_2SO_4.$$

It is intended that so far there should be a slight excess of sulphate of quinine to insure the precipitation of all the barium. This excess is evidenced by a slight scum, consisting of crystals of the undecomposed sulphate, floating upon the surface of the liquor. The dish is then transferred to the lamp and precipitated carbonate of barium added whilst stirring, and in small proportions, until the last trace of sulphate is decomposed and the crystals are replaced by a fine oily pellicle. This simple index serves to point out a state of absolute purity as regards the liquor, providing that the salts used are pure—*i.e.*, it will be found to contain neither sulphuric acid nor barium. The mother-liquor, evaporated over a water-bath, yields a further crop of crystals. The crystals should be air-dried or dried at a gentle heat. There is none, or, under certain circumstances, only a partial decomposition between sulphate of quinine and chlorate of potassium. Indeed, a solution of sulphate of potassium is capable of decomposing chlorate of quinine.

On Liquid and Dried Pepsine, by M. Besson.*

M. Besson first endeavoured to find out whether pepsine could be preserved and used in a liquid state, or whether it could be dried without losing its properties, and the result of his experiments is that pepsine preserved and used in the liquid state possesses all the properties attributed to it by chemists and physiologists, but that it loses them entirely by the simple fact of drying. The following are the experiments on which M. Besson founds his opinion:—

Take from the stomach of a dog 200 grammes of gastric juice, which divide into two equal parts; into one put ten grammes of some meat cut up fine; put the whole into a stove heated to 35°, and in less than five hours the digestion will be completed—that is to say, the meat will be perfectly disintegrated to a solution or homogeneous pulp, with the characteristic odour.

Then dry, with all the necessary precautions, the remaining portion of gastric juice, triturate with starch, and steep it in 100 grammes of distilled water, place it in contact with ten grammes of meat, and treat it in the same way as the first portion. At the end of the five hours no digestion will have taken place, and putrefaction ensues if the experiment be prolonged.

* *Journal de Pharmacie et de Chimie*, iv. 51.

Convinced by these experiments that pepsine should be preserved and used in the liquid state, M. Besson has endeavoured to discover the average quantity of pepsine contained in the rennet bag of the calf, in order to avoid the trouble and difficulty of making a fresh estimation each time. He found that the quantity varies in each rennet bag, which may be accounted for by the degree of development of the organ, the age of the animal, and the state of its health. But of fifty or a hundred rennets the average is 0·45 gr. of pepsine each—that is to say, the equivalent of eight grammes of Corvisart's amylaceous pepsine.

New Facts relating to Fixed Oils, by M. J. Nicklés.

There exists in the commerce of southern France an oil called oil of apricots, which resembles the oil of sweet almonds in appearance and many of its properties, but is cheaper, and is used for adulterating the latter oil. The author was called upon to assay a sample of oil of sweet almonds suspected of this adulteration. He found that oil of apricots was susceptible to the action of hydrated lime in powder, forming with it an emulsion, which slowly takes an unctuous consistence; on the contrary, oil of almonds is not emulsified in this case. By repose the calcareous powder separates little by little and leaves the oil clear.

But when a certain quantity of oil of apricots is present it emulsifies on agitation, and on standing the unctuous compound of oil of apricots and lime is deposited, and may be separated by filtration. This unctuous matter, which is neither an oil nor a soap, melts in the water bath, and becomes a limpid liquid, which concretes on cooling; but less dense than water, it floats on boiling water unchanged, except in consistence. It is soluble in hot oil, but on cooling it separates as a white cloudiness, more or less dense, which can be removed by filtration. This unctuous compound may be freed from any excess of lime by filtering hot, and is soluble in bisulphuret of carbon. The following is the author's process for applying the test.

Take 185 grains of the suspected oil of almonds, and agitate it with about 23 grains of hydrate of lime, then heat it at a temperature below 212° F., filter hot in a heated funnel. By cooling the filtrate by ice-water, the oil loses its transparence if oil of apricots is present. The author finds olive oil and oil of colza behave like oil of almonds; whilst the oils of hemp seed, poppy seed, groundnuts, walnuts, and linseed produce more or less of this unctuous matter in the presence of hydrate of lime; cotton-seed oil gives but very little; castor oil forms a thick coagulum almost like resin.

The author believes this process may be utilised in regard to the three non-coagulable oils above stated.—*Journ. de Pharm.*, May, 1866.

On the Adulteration of Resin of Jalap with Aloes.—M. Daenen (*Bull. Soc. Pharm.*, Brux.) calls attention to a specimen of resin of jalap, which he was led to suspect, by its bitterness, not to be pure. It was friable, and gave a yellowish-gray powder, nearly insoluble in ether, sulphuret of carbon, or chloroform; entirely soluble in alcohol of 28° Baumé, and partially soluble (30 per cent.) in distilled water, liquid ammonia, and an aqueous solution of carbonate of soda, when pure resin of jalap is insoluble in these three last menstrua. It also afforded carbazotic acid by the action of nitric acid, and was not affected by chlorinated soda solution in a manner to indicate guaiacum.

PROCEEDINGS OF SOCIETIES.

ROYAL SCHOOL OF MINES, MUSEUM OF PRACTICAL GEOLOGY.

A Course of Twelve Lectures on Chemical Geology, by Dr. Percy, F.R.S.

Lecture No. IX.

We will proceed this morning with the subject of coal. I was calling your attention on the last occasion to the gradual alteration in composition of coal, and we were tracing that alteration successively from wood at the one extreme to anthracite at the other. I pointed out particularly the relative increase of carbon. Now, here is another relation which it is well to point out—one of considerable importance in a practical point of view. You remember I said the hydrogen is always in excess of that required to form water with the oxygen present. We shall find now, on examining the same series of bodies — wood, peat, lignite, certain varieties of coal, and anthracite—that there is a gradual increase in the proportion of hydrogen above that required to form water with the oxygen present. This table shows the increase of the hydrogen over the oxygen.

1	1·80
2	2·89
3	3·07
4	3·47
5	3·62
6	4·09
7	2·63

No. 1 represents the increase in wood; No. 2, in peat; No. 3, in lignite; and the numbers below represent the increase in the various kinds of coal to which I called your attention. You see there appears to be an exception in the case of anthracite, the last in the series; but possibly this may not prove to be exceptional. In all the other cases you will notice a marked gradual increase in the proportion of hydrogen as compared with that of the oxygen.

I said that the production of coal from woody tissue may be explained by the elimination in greater or less degree of three things—namely, marsh gas or fire damp, of which I showed you a specimen on the last occasion, CH_2 (using the old notation); carbonic acid CO_2; and water HO. It would be possible to present to you a series of formulæ which would make this perfectly evident. To those who are curious in this inquiry, I may mention that the work of Bischoff on "Chemical Geology" will furnish very ample information. There you will see a great number of formulæ illustrating this point most excellently. You have all noticed, I have no doubt, that on stirring up a muddy pool where there is a large quantity of vegetable matter undergoing decomposition, bubbles of gas escape. Well, that gas is fire damp or marsh gas, with a certain proportion of carbonic acid. This is the sort of gas we find escaping in coal mines now-a-days.

Nitrogen is always present in coal, and generally in about the same proportion per cent.—say from 1 to 2 per cent. It is one of the most fixed constituents of coal. We find it even in anthracite. I have never yet seen a specimen of coal free from nitrogen. Of the products of the destructive distillation of coal—those which are produced when coal is heated in a gas retort—some are condensable and some are gaseous. Well, the condensable will always be found to have an alkaline reaction, due to the presence of ammonia, and that ammonia is to be explained by the fact of the coal containing nitrogen.

Sulphur exists always in coal. I think I may say "always." I do not know a single exception. I believe there is none. There are some points of interest concerning the presence of sulphur in coal. It is found in three distinct states of combination. First of all we have the sulphurous pyrites—common pyrites. You have all

seen that shining stuff in coal—bisulphide of iron, or iron pyrites. It occurs sometimes so finely diffused throughout the coal, that the naked eye fails to detect its presence; at other times in exceedingly delicate films, almost imperceptible, if I may use the expression. Sometimes it occurs in small masses, and then again in lumps, and sometimes in actual veins. It is this pyrites which, on exposure of the coal to the conjoint action of air and moisture, undergoes decomposition, being oxidised and converted into sulphate of peroxide of iron. The first product of the action is the sulphate of the protoxide of iron. The sulphur is oxidised and the iron is oxidised, and we get green copperas—that which gives an inky taste to water coming from coal mines. Well, by the further action of the air, that salt undergoes oxidation and becomes converted into this sulphate of peroxide of iron, which makes its appearance in the coal of old gate-roads in pits, or those roads by which the coal is gotten. In these cases you may see yellow patches consisting of this substance. It is owing to the presence of the pyrites that the weathering of coal takes place sometimes very rapidly, and the coal becomes wholly disintegrated—reduced almost to powder. We have specimens illustrating this in some of these jars. Here is one from the Forest of Dean, which I have preserved on purpose to show this fact. It contains pyrites diffused through the mass, and on exposure to the air the coal falls to powder. That is a serious drawback on all coal intended for storing for steam navigation. You will find also, as another product, that peculiar white, silky, delicate, crystalline body, which is a kind of iron alum—not a true iron alum. It consists of a combination of sulphate of alumina and sulphate of protoxide of iron with a small quantity of water. The alumina is derived from the shale which is present in coal, and the alumina is acted upon by the sulphuric acid generated by the oxidation of the pyrites. Here is a specimen received a short time ago which will well illustrate this action. This coal when exposed to the air for a certain time becomes disintegrated, and that fact is due entirely to the interposition of pyrites. There is one which we have plunged into water and then exposed to the air. The action is very rapid, and in the course of a day or two this yellowish-brown colour was produced. It is the substance I before referred to as misy. During the oxidation of this pyrites much heat is developed, and if there be a large quantity of pyrites present, that heat may be sufficient to ignite the surrounding coal. Of the different hypotheses set up to explain the spontaneous ignition of coal pits—a very serious accident which not unfrequently occurs—that of the oxidation of pyrites is, perhaps, the most generally accepted. There is no doubt that if the pyrites be present in large quantity it is amply sufficient to explain the fact; but I am strongly impressed with the belief, from what I have seen, that there may be another cause—namely, the rapid oxidation of the coal when reduced to a state of very fine powder. There is no doubt that oxygen is absorbed, with the production of carbonic acid, and that may go on until actual ignition takes place. I have observed the phenomenon myself in coal pits. The first coal has a peculiar odour, which in Staffordshire is known by the name of "fire stink"—to use the good old Saxon expression—and it suggests to me precisely the odour produced by the distillation of coal at the lowest possible temperature. The pyrites occurs in some coals to such an extent as to be an object worthy of extraction, that pyrites being now much in demand for the purpose of making sulphuric acid.

But sulphur exists in coal, as I have said, in three states. The second state is in combination—for example, in sulphate of lime. It is certain that sulphuric acid is present in certain coals in combination with a base. We have ascertained that beyond possibility of question. The third state to which I refer is one of so-called organic combination. We find on the analysis of coals that there is frequently much more sulphur present than can be explained by the sulphuric acid existing in the coal, or by the iron pyrites present in the coal. We therefore infer, and reasonably too, that that sulphur is in a state of organic combination, just in the same way as it exists in hair and nail and other organic matter. Recently a mineral has been analysed by Mr. Church, which he has called tasmanite, of which we have a specimen in the Museum. It consists of carbon, hydrogen, and sulphur in combination as an organic body. The composition is—carbon 79 per cent., hydrogen 10 per cent., sulphur 5 per cent., and oxygen 5 per cent., the sulphur being in organic combination. Possibly, on further examination, it may turn out that we have some compound of this kind actually existing in coal. Whether that discovery be made or not, it is perfectly certain that coal does contain sulphur frequently in organic combination.

All coal contains water to a greater or less extent, and this water may be expelled at a comparatively low temperature. Ordinary bituminous coal contains 4 or 5 per cent.; but there is a variety of coal to which I shall direct your attention specially directly—lignite—which always contains, I believe in all circumstances, a very large quantity of water, and I believe, indeed, that this water, when accurately determined, will enable us to decide whether the coal is a lignite or not; at all events, it will in many cases.

All coal contains, as you would naturally expect, a sensible amount of inorganic matter. The ash left on the combustion of coal is this matter. That ash is derived partly from the inorganic constituents existing in the woody matter from which the coal has been produced, and partly from those other matters which have been accidentally washed into the coal bogs, or whatever you may choose to call them, during the production of coal. Whatever theory we adopt with regard to the formation of coal—whether it be formed *in situ* or from drift wood—it is certain that sand and other inorganic matter has been washed in in the process of the conversion. The common shale, for example, which we find in alternate beds with coal, demonstrates this. Sometimes we find a single lump of coal showing shale interlaminated throughout. That shale is one of the best examples we can give of coal containing inorganic matter not derived from wood. The shale is not derived from the inorganic matter existing in plants, because it contains silicate of alumina, which is not a constituent of the mineral matter in plants. I will give you a well-known analysis of the shale of coal—an analysis by Mr. Taylor, of the North of England:—

Silica	62·44
Alumina	31·22
Sesquioxide of iron	2·26
Lime	0·75
Magnesia	0·85
Potash	2·48

Now, it must not be supposed that the sesquioxide of iron actually existed as such in the shale. It may have been, and no doubt was, the result of the process of incineration adopted in the analysis. The iron most likely occurred in the coal as protoxide, and was converted into peroxide. In another analysis of shale before me, there is 31·4 per cent. of silicate of alumina. The quantity of shale existing in coal varies very considerably, as every one knows, and, as I remarked on the last occasion with respect to the amount of shaly matter in coal, it is impossible to say where coal ceases and where shale begins. There is no point of demarcation between the two.

One interesting constituent of coal is potash or soda, which indicates or suggests the precise condition under which coal may have been produced—proximity to sea-water.

Having made these general remarks concerning coal, we will pass on to consider certain classes of coal with more detail. The first in order is that class to which I have

referred several times already—namely, the lignites, or wood-like coals, as they are sometimes very properly called. We have them sometimes closely resembling wood in structure. Now, if you look at that specimen of lignite from Bovey Tracey, in Devonshire, you would not hesitate to say that that was woody tissue; but then, on the other hand, some are so much like ordinary coals in appearance, that you cannot tell the one from the other. To the woody varieties of lignite the Germans have applied the term "bituminous wood." Between the two extremes we have every degree, some being more or less earthy, schistose, or slaty. These lignites occur especially in geological strata of comparatively modern date. We have, for example, numerous tertiary lignites. The point which is, perhaps, of most importance to remember in connexion with the composition of lignites is the large amount of hygroscopic water they contain. We have made many determinations of the proportion of water in lignites from many parts of the world. I have looked over the recorded analyses of lignites published in various journals and elsewhere, and I infer from these data that lignites generally contain a very large proportion of hygroscopic water—water, you will remember, which may be displaced by the action of gentle heat, without effecting the slightest decomposition in the coal itself. In this respect lignites approached very much to wood. Lignites contain sometimes 15 or 18 per cent. of water, and even more than that; and you may displace this water completely by a gentle heat, but on leaving the dry lignite again exposed to the air it will reabsorb the same amount of water as you displace. I think this point is one of the most characteristic of all with respect to lignites. We find these lignites—or, as they are sometimes called, brown coals—wood-like in structure, earthy, sometimes almost like black soil, so little coherent are they; then, again, we find them compact, like a piece of ordinary coal. Their fracture is either wood-like, conchoidal—breaking like a piece of glass almost—or uneven. Their colour varies very considerably, as you will observe here—from light brown to coal or jet black. They are all non-caking. This is another very important property to remember in connexion with the subject.

What do I mean by the term "non-esking?" Now, if we take the powder of certain coals—those which we are accustomed to burn here in London, from Newcastle-on-Tyne or its vicinity—and heat that powder in a close vessel, without access of air, gradually to a red heat, it becomes, after much smoke, a solid mass. The particles agglomerate and form a solid lump, which will not crush between the finger and thumb. Then again, if we take the powder of some other coals—those from Scotland and elsewhere—and heat it, it remains powder; the particles will not adhere. I know there is one method in which you may obtain a coke from these particles, tolerably coherent, by the action of heat alone, but then that involves a very special condition.

Well, these lignites are non-caking—all the true lignites, without exception, as far as I know. They approximate to wood not only in point of hygroscopic water, but in point of chemical composition. I need not trouble you now with an analysis of these lignites. In a table which I have before me I find one which contains, deducting the ash, 74 per cent. of carbon, 5·88 per cent. of hydrogen, and 20 of oxygen. What I want you to note is the large proportion of oxygen. We shall find, as I pointed out before, that as we pass from lignite to bituminous coal that proportion is continually diminishing. These lignites are found almost over all the world. We have them in this country abundantly at Bovey Tracey, in Devonshire, but there a large quantity of iron pyrites is present, which produces a disagreeable smell when the coal is burned. There is a very valuable work just published, or in process of publication in Germany, on the brown coals or lignites, giving a very exhaustive history of the whole subject, with an account of the plants, figures, and so forth. The term "coal" is generally applied to lignites, but those persons who are connected with coal mines, or who may invest in them, should bear in mind the distinction between lignites and bituminous coals. There are very good lignites, but they are all inferior in heating power to bituminous coals, because of their containing more oxygen, which, you know, is worse than useless. Hence, when you hear of coal being found here and there, be careful to ascertain what coal it is before you invest your money; if it is a lignite, estimate it at its real value.

I will now give you an analysis of different lignites occurring in different parts of the world. I will give you the proportions with the ash deducted, so that you may be able to compare the composition of one lignite with the other. The ash being a variable accidental body, it is clear that unless we deduct it we cannot properly compare two lignites with reference to their essential constituent parts.

	Carbon.	Hydrogen.	Oxygen & Nitrogen.
Lignite from Hesse Cassel	72·48	5·15	22·37
" Philippine Islands	73·85	5·59	20·56
" Desolation Island	70·38	5·68	23·94

You see how wonderfully near the composition of these lignites is. The analysis of the lignite from the Philippine Islands has not before been published. The lignite from Desolation Island, a very out-of-the-way place, is a very remarkable specimen, and was received last year from the Admiralty. There is in connexion with it one point of considerable mineralogical, if not geological, interest, and I do not know any other example of the kind on record. If you inspect it carefully, you will find it seamed with delicate laminæ, white and more or less crystalline. We have endeavoured to collect sufficient for analysis, but unfortunately have not succeeded in doing so, so as to get a satisfactory result. Still, we have got enough to determine the nature of this body. It is a hydrated silicate of lime and alumina. In fact, it is a zeolite. Here, then, you have a coal containing innumerable beads or laminæ of a true zeolite. I do not know any other case on record of the occurrence of such a body in coal. Here we have it collected very carefully and put aside in a little bottle. In Trinidad we have some very fine lignites. They have been examined very carefully by Mr. Wall, a former student of this Academy, and he has published a monograph upon them.

With regard to the action of chemical reagents upon coal, this part of our subject has been particularly investigated by Frémy, and he has suggested, in fact, that we may be able to determine the geological age of a coal by the action of these reagents. Well, of all the varieties of coal we have to deal with, lignite is most easily acted upon. Here is a specimen of lignite put in nitric acid. You see it has become deep brown and nearly wholly dissolved. There is a specimen of bituminous coal acted on at the same time and under precisely the same conditions. The coal is very slightly acted upon. There, again, is a specimen of anthracite, exposed to the same conditions, but it has not been acted upon at all. So with regard to hyposulphite of soda: lignite is considerably changed by the action of this salt, bituminous coal is slightly affected, and anthracite is not at all acted upon. Here are specimens shewing the action of sulphurous acid. This has been going on for a couple of years. The lignite is very speedily acted upon by this acid. Here is the result of the action of potash on these three varieties of coal. The potash forms a deep brown solution of the lignite, and the odour evolved from this solution is remarkable. I do not know what it is at all. The whole of that lignite is dissolved; the bituminous coal to a considerable extent, but still not wholly; the anthracite not at all. The products here are very well worth the attention of chemists. Perhaps they are not very interesting now, but I have no

doubt that inquiries like this, continued for a long time, would yield information of great value.

With regard to the ashes of lignites I need not say much. They are exactly the same as the ashes of ordinary coal. In some lignites we find bodies of interest—for instance, arsenic has been detected by Daubree in a tertiary lignite from the lower Rhine, and we have also found arsenic in a bituminous coal of this country.

I will call your attention next to the great class of bituminous coal. Now, what do we mean by bituminous coal? Well, it is a very indefinite term. It is used by different authors, unhappily, in different senses. First, we have it applied to those coals which burn with a smoky and bitumen-like flame. Then we have it put down to represent the volatile matter which escapes when coal is heated in an open vessel. Then again it is employed to represent the oxygen, nitrogen, and hydrogen existing in coal. These are three different senses. It is supposed by some that these bituminous coals which we are accustomed to deal with in London contain the mineral bitumen; but it is no such thing. We cannot extract any by means of solvents.

Bituminous coals vary in physical qualities as well as in chemical composition. They are all solid, more or less brittle, and opaque. Their lustre differs considerably from dull to shining. Their colour varies from brown to black. The colour of the powder is always brown, or more or less brown. Then, some of them soil the fingers, and some do not. Like cannel coal or jet, which is only a variety of cannel coal, they break remarkably—sometimes in geometric forms, more or less cubical or rhombic; but do not be misled by this: it has nothing to do with crystallisation. People sometimes talk of the crystallisation of coal: there is no such thing. It is not crystallisation which coal assumes upon cleavage. Then, again, these coals sometimes present a conchoidal fracture. They all burn with a more or less smoky flame, and all yield, when heated in a close vessel, the product called coke, which contains all the fixed inorganic matter of coal.

There are two or three—we will say three—distinct classes of these coals. First of all, when speaking of these coals, we should be careful to inquire whether they belong to the caking or non-caking class, because much depends upon that. The caking coal can be applied for certain purposes, but not for others; so with a non-caking coal. That is a great distinction among these coals. Then, again, as to composition, I gave you three varieties in the last lecture: they were three typical general expressions of three kinds of coal, and represented the three kinds to which I am about to advert. This classification of these bituminous coals is founded on a large number of analyses, and I find it every day confirmed. First, we have bituminous non-caking coals, rich in oxygen; and in so far they approximate to wood or lignite. They are the next step to lignite properly so called. Then we have the caking coals; and lastly, we have the non-caking coals, rich in carbon. The non-caking, rich in oxygen, are represented by our South Staffordshire coals, Scotch coals, and coals from various other parts of the world. They burn with a long copious flame. Then we have the caking coal, which every one knows; and there is the non-caking coal rich in carbon, which approximates nearly to anthracite. You will be good enough to remember these three typical formulæ: they refer to these three varieties of coal—non-caking rich in oxygen, caking coal, and non-caking rich in carbon. It is the last variety which forms such a valuable steam coal. It burns with a bright, hot, short flame, and contains a comparatively small amount of oxygen. One variety contains only 7.36 parts of oxygen to 100 of carbon, whereas the non-caking coal rich in oxygen contains about 21 parts of oxygen to 100 of carbon. In the analyses of lignite I gave you just now, I stated the percentage composition. The proportion of carbon was about 72 per cent., and that of the oxygen 20 per cent. or upwards. There is no marked difference between these varieties of lignite and coal. They pass by insensible gradations into one another. You cannot say where one begins and the other ends. If coal be vegetable matter which, during a long period—I mean long in a geological sense—has been undergoing a natural process of decay, or conversion from wood into a substance more or less resembling carbon, then it is evident that there must be—I was going to say an infinite series of perfectly gradual changes—changes from one into the other, so that we might, if we could get a sufficient number, place before you such a series of coal as would represent that transition by successive stages. It is a matter of time, so to speak. It is perfectly true that there are other influences at work. You will very naturally say to me, "If you assert that the coal is nothing more than the product of a natural decay, or natural change of woody tissue, how is it that we find all these varieties in coal—varieties in point of physical character and varieties in point of composition?" Well, the question of composition is, I think, easily answered: it is a matter of time and other conditions—temperature, for instance, and, it may be, pressure, and so forth. Now, to give you an illustration of this, certain coals are not fiery; they do not contain fire-damp at all. Well, it is perfectly evident that during the formation of that coal the gas has been able to get away; but in some coal pits the gas has not been able to get away; it has been retained, and sometimes it bursts out under great pressure and fills the coal pit in two or three minutes. Then, again, the presence of hot water and the proximity of igneous rocks, and so forth, are all conditions which have to be taken into account. Variety of composition in different coals does not at all invalidate the general proposition, that all coal is nothing more than the result of the conversion of woody matter, or the decay of woody matter, or its gradual conversion into a substance resembling carbon as nearly as may be. There are many other points of great interest bearing on this question, but I find the time admonishes me to pass them by.

With regard to the caking quality of coal, I may mention to you a very curious point—that some of these coals cake when freshly taken out of the pit, and cease to cake or form coke after exposure to the air for even a short time. I say there is no doubt whatever of the existence of fire-damp in coal pretty much as air occurs in charcoal. You may hear it escaping from coal in the pit, and you may get it from the coal after it is taken from the pit. Only this morning the paper tells us of an explosion having taken place in some coal which was stored in a ship. That explosion was due to the gradual elimination or escape from the coal of the gas I have spoken of after the coal was taken from the pit and stored in the vessel. The gas became mixed with common air, and consequently an explosion was the result upon the mixture becoming ignited. Nothing can be plainer than that.

It is very important, when speaking of coal, to pay attention to its remarkable varieties—varieties of physical character, varieties with respect to the mode of burning, varieties also with respect to composition.

There is one variety of coal we must mention here particularly—namely, the well-known cannel coal, which sometimes occurs in immediate proximity—nay, in alternation, with ordinary coal. Here is a piece of cannel coal from Wigan, and a very fine illustration it is, because it shows how one may occur in combination with the other in the same pit. Cannel coal varies very much in point of properties. Here is a specimen in which it is smooth; here it is rough and dark; here it is of a deep brown colour, and does not stain the fingers. It contains a large amount of hydrogen in excess of that which is required to form water with the oxygen present. The name is corrupted from the word *candle*, for a small piece of this coal may be

ignited even at a candle flame, and will then burn away. We have fine specimens in different parts of England. Some of the finest occur at Wigan. It is found also in North Wales. I have examined some from the Leeswood colliery, and I think this is one of the finest I have ever seen. There is also the famous Boghead cannel in Scotland. Curly cannel is the best, and is admirably adapted for gas-making. It fetches a guinea or thirty shillings a ton. It is especially adapted for making paraffin oil.

The last coal to which I must direct your attention is anthracite. Now, anthracite is apparently the last stage of conversion, or nearly the last. It may, practically, be regarded as carbon. It contains, it is true, a little hydrogen, and a little oxygen, and a little nitrogen. These anthracites are black, shining, sometimes almost metallic in lustre, breaking with an irregular fracture, exceedingly difficult of ignition. There is no gas to burn. It is true we can in a particular way generate a gaseous flame, because if we ignite this anthracite in a mass—say in a furnace, for example—when the oxygen comes in contact with the incandescent coal, we get first of all carbonic acid produced, and that carbonic acid, on rising through the incandescent mass above it, takes up another portion of carbon, and becomes converted into carbonic oxide. That carbonic oxide is a combustible gas, and on leaving the furnace it will burn with a flame; so, although I say that the anthracite does not contain hydrogen, you see how we can get flame from it. The flame, however, is obtained indirectly, as I have explained, and not by the direct burning of hydrogen. In other coal the flame is due to hydrogen, but in this anthracite it is due to the formation of carbonic oxide. There is a serious defect in the burning of anthracite, especially that of this country. It decrepitates, or becomes reduced to small particles, on the application of heat. I have seen specimens reduced to absolute powder in that way. That is a fatal objection to its application for the purpose of smelting iron. This anthracite I hold in my hand comes from China. There is a magnificent coal-field in China, near Pekin, about 300 miles in extent. We obtain steam coal thence, which is brought over in her Majesty's ships. The Chinese are rather jealous of European interference. Specimens of the coal have been tried, and found to coincide with other anthracites.

There is a fine coal in Borneo. It is a fine coal apparently, as far as we can judge from composition—a true coal of the carbonaceous period. Exclusively of ash, it contains 78·02 parts of carbon, 6·02 of hydrogen, and 15·96 of oxygen and nitrogen. Then in the island of Sardinia there is a coal which was supposed to be a lignite; it contains a large amount of ash, but chemically I should say it was a true coal. Then we have had coals from Brazil, which appear to be true coals of the carbonaceous period, but unfortunately they are very much deteriorated in consequence of the presence of a large amount of iron pyrites. When the pyrites is deducted, they have essentially the composition of true carbonaceous coals.

In some coals we find associated matters of great interest. There are some fine resinous matters met with in some coal. Here is a Tasmanian coal, in which occur large masses of resinous matter. These matters have probably been derived from the trees of which the coals are formed. Amber is contained in a coal from India. These resinous bodies are most unchangeable in their character. They have not been properly investigated in reference to their presence in coal. I have spoken of arsenic in coal. We have found it in coal of this country—a Nottingham coal. Galena has also been found in coal. There is a fact with regard to anthracite of which I have not spoken—namely, the presence of copper. We have examined it from time to time, and found it associated with that metal. I might go on enlarging on this subject, for it is difficult to know where to stop; but as I have so many things to do, I must draw to a close with regard to coal. Before doing so, however, there are one or two points with respect to coal to which I wish to call attention.

A great deal has been said of late about the duration of our coal, and evil prophecies have been put forth. The extent of our coal-fields is pretty well known, but probably coal will be found over a much larger area than at present known. Our rate of consumption is very large—say between 80,000,000 and 90,000,000 tons per annum, including the coal exported to other countries. It is not for me to condemn the exportation of coal. It is a subject open to grave differences of opinion, but in parting with our coal we are parting with our natural power. We are selling a power which can never be replenished—a power derived entirely from the operation of the sun, and stored up for us during millions and millions of ages. Whether it be proper to sell that power it is not for me to decide. It is derived from the sun's force. All coal is the product of the decomposition of woody matter of one kind or other by a natural process of decay. Now, no plant can exist without the agency of solar light. That light is essential to enable the plant to decompose the carbonic acid of the air upon which it mainly lives, and to separate the carbon from the oxygen. That separation, then, is effected by the operation of solar force, and the carbon thus set free is the carbon which comes down to us in the form of coal. The carbon of coal being the carbon which was separated in former geological periods by the action of the sun, we are, therefore, right in asserting that our coal is so much accumulation of sun force. There is an excellent book published this year on the coal question by Mr. Jevons, which I have read with much interest.

But I have digressed somewhat. To recur to the question of the exhaustion of coal. We are now going on at an enormous rate—about 90,000,000 tons a year, as I have said. But these 90,000,000 tons do not represent the actual exhaustion, because in the getting of coal, especially in some cases, there is a large amount of coal wasted. Perhaps in past times the waste has amounted to about one-half. The waste occurs in the form of small coal or slag which is buried in our pits never to be gotten again—at all events, not for some centuries to come, or while coal is at its present price. This slag contains as much heat-giving power as the solid coal. Hitherto the price has been so low that manufacturers have not cared to burn this small coal and get the heat out of it; but owing to the rising price they have been driven to make use of fuel which they would formerly have despised. There is no doubt that there is a large amount of coal in this country, which is very deep, and which will be inaccessible for a long time to come. It is impossible to say how far down we may go, but the increase of temperature at great depths is an obstacle. However, bold is the man who will set a limit to what human power can do. It may be too expensive to get at these deep coals until we have exhausted the coal-fields of our neighbours on the Continent and in America, for still they come into competition with us. There are numerous coal-fields in various parts of the world, especially in America. Of all coal-fields known, I suppose that in North America is by far the largest. It is only scratched upon the surface yet. The time may possibly come when our own coal-fields will be exhausted. I do not know whether in future ages England will be a sort of watering-place for other countries, but certainly our own coals will have disappeared long before there is any serious inroad made upon the American coal-field. Coal occurs in France and Prussia—in France under the chalk, the intervening measures being absent. Then there are the Belgian and Austrian coal-fields; and we have colonial coal-fields of very great value in Nova Scotia, Australia, and elsewhere.

With regard to the time our coal-fields will continue to yield—whether one hundred years or two hundred years—

no man can pronounce satisfactorily upon that point; for the moment foreign coal comes into competition with ours the working of our own coal-fields will stop. They will last our time, and no doubt some generations after us; but certain it is that the process of exhaustion is going on at a great rate, and must go on until the supply ceases. We shall be rendered then absolutely powerless, and shall have to depend upon peat or wood for fuel. At all events I think the lesson to be learned is that we ought to economise this power more than we do; for the waste of coal is enormous, not only in the getting of it, but in the consumption of it. Take the case of a common British fireplace—why, I suppose that nine-tenths of the heat generated there is entirely wasted. There is some talk about the possibility of finding a substitute for coal, but I think that success in that direction is very improbable. Can you conceive of anything less expensive as a fuel than coal—the product of sun-force during past ages? We get our power by just setting a spark to it. There is the oxygen in the air outside it, and there is the carbon in it, and as soon as these come in contact under suitable conditions, we get any amount of force. We can no more create force than we can create matter. Sometimes people not very well informed say, "Oh, when this coal is gone we shall get some other source of heat." I see no source of heat-giving power except that which may be derived from tidal action, but it will be an expensive matter to get heat from tidal action. We can get heat out of force now, but it is a very costly thing to do. There has been a notion put forth of drawing heat from the sun's force in the great desert of Africa, by means of thermo-electric batteries. Well, force might there be got and transformed into heat. It is one of those theoretical and interesting possibilities which I am afraid will not be realised.

I might have spoken of coal-like matters under the head of petroleum or coal oil, but the subject would take one or two lectures, and I must omit it on this occasion. Here are some samples of these matters—Canadian, Grecian, and Wallachian—for which I am indebted to Dr. Ward.

I will now proceed to make a few remarks upon the diamond, for these illustrations of which I am very much indebted to Mr. Tennant. The diamond is nothing more than a form of carbon. It is crystallised carbon. Carbon crystallises, as we know, in two distinct systems. One is the rhombohedral, in which state it is graphite or plumbago, which is opaque and difficultly combustible. Then we have carbon crystallised in the cubical system. It is then the diamond, one of the most beautiful and the most glorious of all gems, but one of the most mortifying to the chemist, for what would appear simpler than the idea of crystallising carbon? Numerous attempts have been made to convert carbon into a crystalline form, but hitherto entirely in vain. The diamond occurs of various and very beautiful colours. You will see some splendid illustrations of these colours in the case before you—green, yellow, various shades of topaz, brown, pink. The diamond is sometimes opaque, here is such a specimen; and there is a variety of diamond we meet with which is black and coke-like. There is one in the form of the octahedron, belonging to the cubical system. Then we have the more complex form, which is used for cutting glass.

ACADEMY OF SCIENCES.

August 27.

An important paper was communicated by M. P. A. Favre. It was entitled "*A Study of Chemical Reactions by the aid of the Heat borrowed from the Pile.*" The description of the author's mode of experimenting is too long to be quoted; we give only his conclusions. When a body is decomposed by the battery the constituent elements in separating borrow or absorb a larger amount of heat than they disengage again in combining under ordinary circumstances. Thus, in the *nascent state* bodies possess an excess of heat, which they give up on becoming modified to the ordinary state. We may suppose, then, that in chemical reactions, whether of combination or decomposition, the molecules set in motion undergo modifications that precede the combination or follow the decomposition, these modifications being shown by an absorption or disengagement of heat, quite independent of the calorific phenomena which accompany the chemical combination or segregation. The author's experiments revealed another fact—that secondary actions take place in the battery, accompanied by a disengagement of heat which is not turned to account in the current, and therefore he says that electro-magnetic machines cannot dispose of all the heat set in action in the battery.

M. Isidore Pierre presented a memoir "*On Silica and the Laying of Corn.*" Some people have supposed that corn becomes laid because of the weakness of the stalk from the absence of silica; but chemical analysis has not supported this idea. M. Pierre has observed that the corn on poor land rarely gets laid, and he believes the stalks in general give way in consequence of an over-development of leaf, which is at once a load for the stalk to carry, a surface to catch the wind, and a hindrance to the free access of air. The remedy suggested is evidently a different style of sowing.

M. Ch. Mène presented a memoir "*On an Iron Mordant used in Dyeing Silk Black.*" It is practically a solution of persulphate of iron. The author goes on to give directions for the manufacture of this, with which we need not trouble the readers of the Chemical News. He subsequently describes the method pursued at Lyons for dyeing silk black, which we shall quote on another occasion.

M. Blondlot presented a note "*On the Crystallisation of Phosphorus.*" The author, with proper precautions, sublimed phosphorus in an atmosphere of nitrogen, and obtained beautiful crystals apparently belonging to the cubical system. While these were preserved from the light they remained bright and colourless; but even in diffused light they soon became red, without, however, altering in form. Red phosphorus, therefore, is not, strictly speaking, amorphous.

NOTICES OF BOOKS.

On the Future Water-Supply of London. By G. W. Hemans, C.E., and R. Hassard, C.E. London: Stanford. 1866.

The future water-supply of London is a subject which imperatively demands serious consideration. Although it must be admitted that the present supply is amply sufficient in quantity for to-day, it must also be admitted that the quality is not all that could be desired. There is good reason to believe, too, that we have reached the maximum quantity that can be obtained from our present sources, and still London continues to grow "as rapidly as a log-built village on a water privilege in Michigan." As larger and larger quantities are taken from the Thames, it is found that the volume of water in the river is becoming seriously diminished, a matter which excites considerable alarm in many minds. Our other sources, and particularly the River Lea, are just now in discredit, and altogether the public mind is ready to entertain any scheme for supplying London with an unlimited quantity of wholesome water.

Several schemes are before the public. Mr. Bateman proposes to bring Bala Lake to London at a cost of eight

millions. The scheme is opposed mainly, we believe, on the ground that it would cost another million or more to compensate people whose supply might be interfered with by diverting the water from its present outlet. The authors of the pamphlet we now notice propose to go to even a greater distance for their supply. Those well-known mountain ranges, they say, of the counties of Westmoreland and Cumberland draining into the rivers Lowther, Eamont, and Greta, and adjoining the lakes of Haweswater, Ullswater, and Thirlmere, possess all the attributes of a locality from which an enormous amount of the purest possible water may be obtained; and the existing lakes can easily and at small expense be adapted to form immense reservoirs for its conservancy and storage, at convenient altitudes for the water to be drawn off and conveyed by gravitation to London. The entire district is bare hill pasture and rock of the primitive formations, and excepting a small area in the vicinity of Ullswater, which can easily be excluded from the scheme, is free from mineral workings or other sources of contamination, and the waters are of remarkable purity and softness, as the following analyses by and letter from Professor Way will show:—

Grains per Imperial Gallon.

	River Lowther.	Haweswater Lake.	Ullswater Lake.	Thirlmere Lake.
Lime	1·54	0·50	0.81	0·42
Magnesia	0·50	0·18	0.20	0·14
Soda	0·80	0·71	0·51	0·46
Chlorides of sodium and potassium	0·48	0·40	0·69	0·77
Oxide of iron, silica, &c.	0·50	0·25	0·20	0.05
Sulphuric acid	0·51	0·51	0·37	0·44
Carbonic acid	2·05	0·82	1·03	0·56
Organic matter	0·62	0·62	0·35	0·77
Total impurity	7·00	3·99	4·16	3·61
Hardness before boiling	5·2°	2·0°	2·1°	1·5°
Hardness after boiling	4·4°	1·8°	2·1°	1·5°

These results, the authors are careful to add, although so favourable, exhibit the waters in their worst aspect and condition, the samples for analysis having been taken in January last, immediately after long-continued and heavy rains, and include the drainage from the small mineral district, which is intended to be excluded from the scheme.

From the above sources it is proposed to bring 150 millions of gallons for daily consumption in London, and 50 millions to populations along the line of conduit. Of the sufficiency and constancy of the supply there can be no doubt, nor in these days can there be any difficulty in constructing the works. Beyond a tunnel seven miles and a half long under Kirkstone Pass, there would seem to be no extraordinary work required. From the south end of that tunnel the water would be conveyed to London by conduit, tunnel, and iron pipes; the aqueduct would pass by Ambleside and Kendal, and down the eastern side of Lancashire, avoiding the Wigan coalfield, to the east of Manchester and the Potteries district, and to the east of the Staffordshire coalfield and of Birmingham, and onwards towards London, following a route nearly parallel with that of the London and North-Western Railway, and would terminate in a large regulating reservoir, to be constructed to the north of Harrow, at a distance of about twelve miles from Cumberland Gate, Hyde Park.

The cost of this project is estimated at about twelve millions sterling; and with this amount of capital and after paying the present dividends to all existing water companies, the projectors see their way clearly to the realisation of large profits. We are not in a position to dispute their figures, which, indeed, look reasonable; and we need only express a hope that the scheme may receive attention. The quality of water, the quantity to be obtained, and the advantages afforded by the altitude of the source, are such, we believe, as cannot be found in any other part of England.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W.C.

1752. H. A. Bonneville, Rue du Mont Thabor, Paris, "Improvements in the construction of furnaces and kilns."—A communication from A. Martin and A. Béranger, Rue Louis-le-Grand, Paris.—Petition recorded July 2, 1866.

1912. G. T. Bousfield. Brixton, Surrey, "Improvements in the manufacture of certain alkaloids derived from aniline and its homologues, and in their transformation into colouring matters suitable for dyeing and printing."—A communication from A. Poirrier and C. Chappat, Rue d'Hauteville, Paris.—July 23, 1866.

1934. C. E. Brooman, Fleet Street, "A new or improved process or method of treating armour plates to render them inoxidisable."—A communication from M. Bernabé, Paris.

1938. W. E. Newton, Chancery Lane, "Improvements in treating iron for the purpose of converting it into steel or hard metal, and for plating or coating and hardening and tempering iron and steel."—A communication from E. Savage, West Minden, Conn., U.S.A.—July 25, 1866.

Notices to Proceed.

1023. J. Sparrow and A. Poole, Frood Iron Works, near Wrexham, Denbighshire, "Improvements in collecting the heated gases from blast furnaces, so as to utilise the same."—Petition recorded April 10, 1866.

1971. G. T. Bousfield, Brixton, Surrey, "Improvements in the manufacture of fuel from peat and such-like vegetable."—A communication from L. Elsberg, New York, U.S.A.—July 31, 1866.

CORRESPONDENCE.

Magnesium.

To the Editor of the Chemical News.

Sir,—Can you give me a reason why magnesium is not reduced from its oxide by carbon like other metals? Why should its treatment, as well as aluminium, so far depart from the ordinary rule? Has any one tried to obtain magnesium from magnesia by charcoal at a high temperature?

A Novice.

MISCELLANEOUS.

Death from Swallowing Carbolic Acid.—At Liverpool last Friday the relative of a patient in the hospital who had died of cholera went in a state of half intoxication to see the body in the dead-house. Perceiving a bottle of carbolic acid that had been left in the room, he mistook it for rum, and swallowed a quantity. His death was instantaneous.—*Medical Times and Gazette*, August 18.

Pharmaceutical Conference.—The meeting of the Pharmaceutical Conference was in every respect a success. It received a large accession of members, and the attendance was more numerous than on any previous occasion. Professor Bentley, F.L.S., was President, and delivered an opening address on the study of botany in connexion with pharmacy. At the daily meetings several useful and interesting papers were read, for most of which we hope to find space. The exhibition was considered to

be successful beyond the most sanguine expectations of its promoters, and the dinner given by the resident members to the visitors was an extremely agreeable entertainment.

Composition and Quality of the Metropolitan Waters in August, 1866.—The following are the Returns of the Metropolitan Association of Medical Officers of Health:—

Names of Water Companies.	Total solid matter per gallon.	Loss by ignition.*	Oxidisable organic matter.†	Hardness.	
				Before boiling.	After boiling
Thames Water Companies.	Grains.	Grns.	Grains.	Degs.	Degs.
Grand Junction . . .	18·31	0·81	0·60	13·5	4·0
West Middlesex . . .	16·80	0·59	0·48	13·0	3·5
Southwark & Vauxhall .	18·67	1·00	0·64	14·0	3·5
Chelsea	18·43	0·65	0·56	13·0	3·5
Lambeth	—	—	—	—	—
Other Companies.					
Kent	27·36	0·70	0·03	17·5	8·5
New River	17·09	0·54	0·22	13·0	3·5
East London . . .	18·19	0·88	0·56	13·0	4·0

* The loss by ignition represents a variety of volatile matters, as well as organic matter, as ammoniacal salts, moisture, and the volatile constituents of nitrates and nitrites.

† The oxidisable organic matter is determined by a standard solution of permanganate of potash, the available oxygen of which is to the organic matter as 1:8; and the results are controlled by the examination of the colour of the water when seen through a glass tube two feet in length and two inches in diameter.

H. Letheby.

All the samples of the metropolitan waters received during the month have been remarkably bright and free from colour, and the proportion of organic matter has not in any case exceeded 0·7 of a grain per imperial gallon of water, while in the East London water it was very little more than half a grain per gallon, and in the Kent water it was only 0·03 of a grain per gallon. The total amount of saline matter in the water derived from the Thames is a little more than it was last month, but that of the other companies is a little less.

Metropolitan Sewage Irrigation.—As we have persistently advocated the scheme for carrying the metropolitan sewage to the Maplin Sands, we have much pleasure in recording the perfect success of a preliminary experiment. The directors caused upwards of 3000 tons of the sand to be brought to the neighbourhood of the outfall reservoir at Barking-creek, and spread it out two feet deep on an acre of land in March last. It was sown with Italian rye grass on April 14 and irrigated with the sewage. Grass cut on July 17, and of only 27 days' growth, represented 14 tons to the acre. Another portion cut before that date represented even a greater weight. We hope this proved success will lead to a very extensive application of the sewage to the grass lands of Essex.

The Welsh Diggings.—Some three or four years since it was generally believed that the auriferous quartz deposits of Wales could be worked to advantage, and that the quantity of gold that could be extracted would prove sufficient to make handsome profits. The temporary success of the Vigra and Clogau mines gave colour to this opinion, and the promoters of gold-mining companies found but little difficulty in inducing the public to subscribe to their projects without anything like a reliable inspection of the properties offered having been previously made. The new mines were vigorously worked for a time, but it was soon discovered that the quartz did not yield sufficient gold to make its working profitable. The quantity of gold raised in the whole of Wales during the year 1861 reached 2886 oz.; in 1862, 5299 oz.; in 1863, 552 oz.; in 1864, 2333 oz.; and in 1865, 1664 oz. The large decrease here shown indicates that gold mining is on the wane in the Principality, and the mines that continue to be worked give little hope of any increase in the returns. The general opinion prevails that until the inventive genius of the nation has produced a more perfect and economical means of production than is at present in use, Welsh quartz, although containing slight traces of the precious metal, will not be worked with profit.

[We take the above from the *Times* of Tuesday last. We have good grounds for stating that many of the gold mines in Wales which are now unworked, or worked at a loss, would at once pay a profit were the sodium process of amalgamation introduced.—W. C.]

British Association.—The meeting at Nottingham will leave many pleasant recollections in the minds of the members. The attendance was beyond the average, being greater than at Birmingham last year, though considerably below the number of Bath and far below the attendance at Newcastle. Still, numerically, the meeting must be considered a success. The attendance, we have no doubt, would have been larger but for the exorbitant price demanded for accommodation in the town. The lodging question is one to which we would call the attention of all future local committees, as of primary importance. As a rule, we may say without offence, the members of the British Association are not rich; and it would be well if the local committees could prevail upon their fellow-townspeople to agree to a tariff of reasonable charges suited to the accommodation offered. Quitting this disagreeable part of the subject, we may notice with the utmost cordiality the munificent public hospitality displayed on the occasion, which almost effaces all recollection of private greed. The *soirées* were great successes. It would be impossible, in the short space we can devote to the matter, to give anything like an adequate description of these entertainments, or to enumerate a tithe of the objects of interest displayed. They gave unbounded satisfaction to all present, except perhaps to Mr. Ladd's assistant, who so narrowly escaped a dangerous wound at one. The excursions were admirably varied to suit all tastes, and gave the utmost pleasure. Newstead Abbey and Belvoir Castle, Charnwood Forest, the Peak Cavern and Matlock, and the Derby Railway Works in turn delighted romanticists, geologists, and mechanists. If the truth must be told, the scientific results were but small, and it can hardly be said that the scientific interest of the meetings increases. We are somewhat inclined to the opinion of an evening contemporary that the Association needs an editor or editors, if these meetings are not to be allowed to degenerate into opportunities for advertising small inventions and trotting out scientific hobbies. But, due allowance being made for these perhaps unavoidable drawbacks, enough remains in such meetings as this held at Nottingham to attract people really devoted to science, while the educational and stimulating influence of the gatherings is beyond all question. We must most heartily thank the people of Nottingham for their hospitable reception, and wish for the Association a continuance of such successes.

ANSWERS TO CORRESPONDENTS.

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*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Chemicus.—See Dr. Faraday's paper in the *Philosophical Transactions.*

D. J. O.—The amount varies with every sample of naphtha. The operation must be repeated once or twice.

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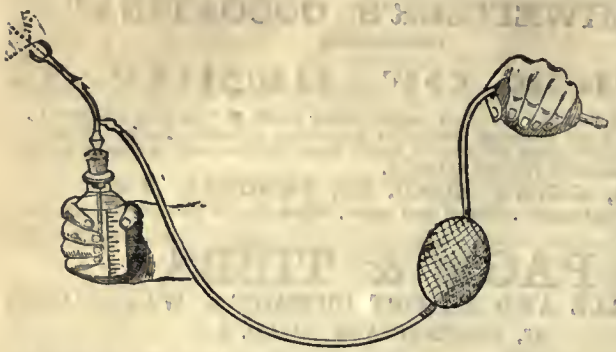

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FORECASTS OF THE WEATHER.

Attentive readers of the morning papers have missed for some time past the paragraph in the meteorological report which told the probable state of the weather for the next succeeding day. They will doubtless be glad to learn that there is every likelihood of these forecasts soon being resumed. Upon the death of the late Admiral Fitzroy, the forecasts, which had been brought to a condition of tolerable certainty by his unremitting exertions, were discontinued, and a correspondence took place between the Board of Trade and the Royal Society with respect to the Meteorological Department. The result of that correspondence was the appointment of a committee to consider and report upon the following questions:—

1. What are the data, especially as regards meteorological observations at sea, already collected by, and now existing in, the Meteorological Department of the Board of Trade?

2. Whether any, and what, steps should be taken for arranging, tabulating, publishing, or otherwise making use of such data.

3. Whether it is desirable to continue meteorological observations at sea, and if so, to what extent, and in what manner.

4. Assuming that the system of weather telegraphy is to be continued, can the mode of carrying it on and publishing the results be improved?

5. What staff will be necessary for the above purposes?

The Report of the Committee has now been published, and the authors of the Report arrive at the following conclusions in respect to the ocean statistics, weather telegraphy, foretelling weather, and observations affecting weather in the British Isles:—

"The collection of observations from the captains of ships is a function which can probably best be performed through the medium of such agencies as a Government Office can command, and which was in fact well performed by the Meteorological Department before its attention was devoted to the practice of foretelling weather. We assume, therefore, that this function will remain with the Board of Trade.

"The digesting and tabulating results of observations is, on the other hand, a function which requires a large knowledge of what the state of the science for the time being requires, as well as exact scientific method.

"This function is one that has not been satisfactorily performed by the Meteorological Department. And we believe that it would be much better, as well as more economically, performed under the direction of a scientific body—such as a Committee of the Royal Society, or of the British Association, if furnished with the requisite funds by the Government—than it will be if left to a Government Department. The establishment already existing at Kew might probably be easily developed, so as to carry into effect such a purpose. It would in that case become a meteorological centre, to which all observations of value (by British observers), whether made on land or at sea, and whether within the British Isles or not, would be sent for discussion and reduction. We have, therefore, in the following estimates, assumed that all meteorological observations made on land, whether at the stations recommended by the Royal Society, or at the lighthouses or coast-guard stations, as well as all observations at sea, shall be referred to and discussed under the direction of such a scientific body as we have mentioned; and we have also assumed that the aid afforded by Government would be in the shape of an annual vote, so made as to leave the Royal Society, or other scientific body charged with the duty, perfectly free in their method and in their choice of labour, but upon the condition that an account shall be rendered to Parliament of the money spent, and of the results effected in each year."

This Report has been communicated to the members of the Kew Committee of the British Association, and from the Report of the Kew Committee just issued, we find that they cordially acquiesce in the conclusions of its authors. They consider the proposed arrangement to fall within the competence of the Kew Observatory.

In the last Kew Report it was stated that many experiments and observations of a nature to advance science were made by the Committee under the sanction of the Association, the cost of each being defrayed by the promoters.

The Committee consider that the suggested observations contained in the Government Report which has been referred to, would be merely an extension of the usual practice of the Observatory; but in consideration of the magnitude of the work proposed, they suggest that the Council should bring the subject before the General Committee, with the view of the Kew Committee being authorised to discuss and make the necessary arrangements with the Board of Trade, should any proposal be made.

In reference to this subject the President of the British Association made some very appropriate remarks in his inaugural address. To assert, he said, that the great departments of Government should encourage physical science might appear a truism, and yet it is but of late that it has been seriously done; now the habit of consulting men of science on important questions of national interest was becoming a recognised practice, and in a time, which may seem long to individuals, but is short in the history of a nation, a more definite sphere of usefulness for national purposes would, he had no doubt, be provided for those duly qualified men who might be content to give up the more tempting study of abstract science for that of its practical applications. In this respect the Report of the Kew Committee for this year afforded a subject of congratulation to those whom he had the honour to address. The Kew Observatory, the petted child of the British Association, might possibly become an important national establishment; and if so, while it would not, he trusted, lose its character of a home for untrammelled physical research, it would have superadded to it the Meteorological Department of the Board of Trade, with a staff of skilful and experienced observers.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Accumulation of the Nitrogen of Manure in the Soil, by J. B. Lawes, *F.R.S., F.C.S., and Dr.* J. H. Gilbert, *F.R.S., F.C.S.**

The authors had been engaged for many years in experiments, in the course of which they had grown wheat year after year on the same land for more than twenty years; on some portions without any manure, and on others with farmyard manure, or with various descriptions of manure. They had published the results obtained in the field during the first twenty years of these experiments, and they were now engaged in investigating

* British Association, Nottingham.—Section B.

the composition of the produce grown under the different conditions, and also the comparative composition of the soils of the different plots as affected by the various treatment. The point to which they chiefly confined attention on the present occasion was the accumulation, and the loss, of the nitrogen which had been supplied in the manure, and not recovered in the increase of crop. After discussing the difficulties of sampling, preparing for analysis, and analysing soils, in such manner as to yield results applicable to the purposes of their inquiry, and describing the methods they had adopted, they called attention to the results obtained, which were exhibited in several tables hung up in the room. The percentages of nitrogen determinable by burning with soda lime were given for the soil of the first, of the second, and the third nine inches, of eleven differently-manured plots, showing the amounts, therefore, to the depth of twenty-seven inches in all. In some cases the accumulation from the residue of manuring was very considerable; but even with the same amount supplied, it varied, both in total amount and in distribution, according to circumstances; the depth to which the unused supply had penetrated being apparently influenced by the character and amount of the associated manurial constituents. The general result was, that although a considerable amount of the nitrogen of the supplied manure which had not been recovered as increase of crop was shown to remain in the soil, still a larger amount was as yet unaccounted for. Initiative results indicated that some existed as nitric acid in the soil, but it was believed that the amount so existing would prove to be but small. In fact it was concluded that a considerably larger portion would remain entirely unaccounted for in the soil than was there traceable, and the probability was that at any rate much of this had passed off into the drains, or into the lower strata of the soil. Finally, it was shown, by reference to field results, that there was not more than one or two bushels of increase in the wheat crop per acre per annum, due to the large accumulated residue of nitrogen in the soil, notwithstanding its amount was many times greater than that which would yield an increase of twenty bushels or more, if applied afresh to soil otherwise in the same condition. On the other hand, it was shown that the effect of an accumulated residue of certain mineral constituents was not only very considerable in degree, but very lasting.

On the Ammonium Amalgam, by F. S. Pfeil *and* Henry Leffman.

For some years the attention of chemists has been directed to the investigation of the substitution ammoniums. Notwithstanding their close analogy to ammonium itself in many respects, we have not been able to find record of any systematic attempt to form amalgams analogous to the well-known ammonium amalgam. The consideration of this fact induced us to commence a series of experiments to determine the deportment of these bodies with sodium amalgam.

A saturated solution of chloride of trimethyl-ammonium was treated with sodium amalgam, and a series of phenomena followed, exactly identical with those which occur in the preparation of the ammonium amalgam. The swelling rapidly subsided, hydrogen gas being given off, and the liquid was found to contain trimethylamine.

Saturated solutions of the chlorohydrates of aniline, conine, morphine, and quinine, and of the acetate of rosaniline, when treated with sodium amalgam, give rise to copious evolution of hydrogen gas, without turgescence.

These experiments (in addition to those recorded by Dr. C. Wetherill) seem to indicate that the physical phenomena of the ammonium amalgam depend entirely upon the retention of gas bubbles, and also that those ammonias which in the free state are, at ordinary temperatures, either liquid or solid, produce no amalgam.

It may be mentioned that a solution of chloride of ammonium in pure glycerine gives rise to an amalgam, but the turgescence is much interfered with by the viscosity of the solvent; and also that sodium amalgam, when placed upon a crystal of chloride of ammonium, produced no reaction until moistened with a drop of water.—*American Journal of Science*, vol. xlii., No. 124.

PHARMACY, TOXICOLOGY, &c.

On the Results of the Micro-chemical Examination of Extract of Flesh, by* H. Deane, *F.L.S., and* H. B. Brady, *F.L.S.*

Since the introduction of the so-called "extractum carnis" of Liebig, so sudden and unexpected a demand has sprung up for concentrated preparations of flesh, that they have become, or are likely to become, an important article of export from those portions of the world where the value of cattle is small, and means of transport easily available.

As there are few chemical operations requiring greater nicety of manipulation than those in which the unstable compounds constituting or contained in animal tissues are concerned, and as the manufacture of the extract must necessarily be subject to variation from this cause, it becomes a matter of importance that we should possess some means of estimating, with a certain amount of accuracy, the relative value of samples which may occur to us. In addition to this, the high value of the article presents an obvious inducement to manufacturers to make their product as large as possible and thereby to increase the average profit upon it.

Having in previous years presented to the Conference some notes on a method which we have been in the habit of employing in our researches on other extractives, we propose on the present occasion to offer the results of experiments which we have been engaged upon during the last fifteen months, on the micro-chemical characters of extract of flesh.

We may repeat in general terms that the microscope may be made use of with advantage in the examination of almost any extract, or solution containing extractive matter, in which the active or valuable portion assumes on inspissation a crystalline form. The fewer the active constituents and the more characteristic their crystalline forms, the more readily are they recognised and their relative proportions determined. Not only does the non-crystallisable extractive matter itself afford no drawback to the applicability of the process, but in many cases it really facilitates the separation of the crystalline constituents on evaporation. The number of active bodies which exist in large proportion in vegetable and, we may add, in animal extracts, so soluble as to remain in an uncrystallised state on the evaporation of a large quantity of solution to a nearly solid condition, is exceedingly limited, and even these may be detected, as we shall presently show, by an after process. The one essential in the practical application of this method of determining the relative values of a series of specimens is, that we shall understand clearly what appearances

* Read before the Pharmaceutical Conference, Nottingham meeting.

the preparation ought to exhibit, and be able to identify the different crystalline bodies in the mixed condition in which they present themselves to our notice. It is not sufficient that we should know merely the forms and crystalline characters of the pure salts and principles, but we must also ascertain in how far the presence of extractive or viscid matters may influence their mode of separation. It is obvious that nothing but the most careful investigation of the appearances of specimens whose value has been otherwise determined will serve as a groundwork whereon to base our conclusions. The plan we have adopted in the investigations about to be detailed has been almost identical with that pursued with reference to preparations of opium, &c.—that is to say, portions of the various extracts have been either mounted for the microscope in the condition in which they are found in commerce, or reduced to a syrupy consistence with hot water placed on the glass while still warm, and allowed to stand until crystals were fully formed. In some instances other menstrua than water were used for the better determination of the crystalline matters. We have also taken advantage of Professor Graham's process of dialysis to determine the relative proportion of crystalline and extractive matters.

The samples of extract of flesh on which observations have been made are as follows:—

1. and 2. Specimens made by ourselves as standards whereby to judge the rest. One of these was made by cold water, the other with water heated to 160° Fahr. Both were prepared from the finest quality of English beef which could be procured, and on a sufficiently large scale to insure a practical value to the result.

3. A specimen prepared in the Royal Pharmacy at Munich, kindly given to one of us by Professor Pettenkofer, on a recent visit to that city. This we look upon as having the seal of official sanction.

4. The South American extract, prepared by Herr Gierbert, and sold with the approval of Baron Liebig.

5. A portion of that at present being imported from Australia.

6. The extract prepared by our friend Mr. Reynolds, from English meat.

7. That supplied by Messrs. Gillon, of Leith.

8. The so-called extract of meat lozenges, introduced by the same firm.

We propose to offer a few remarks on the general characters of these extracts before proceeding to describe in detail their microscopic appearances.

1. Our own cold water extract was prepared by simply macerating carefully selected lean meat, cut very small, in water at 60° Fahr. for twelve hours, and evaporating the liquid obtained, at a temperature considerably below the boiling-point, to the consistence of a soft extract. This was purely an experiment made for the purpose of future reference, and as the amount of extract obtained did not exceed two per cent. on the meat employed, it obviously could never answer in a commercial point of view, the cost being nearly 34s. per pound for the flesh only, without any allowance for fuel and labour. The resulting extract is light-coloured, very fragrant, readily soluble, giving a pale solution of the purest flavour, and highly hygroscopic in damp weather.

2. Our hot-water extract was prepared similarly by maceration, firstly, in cold water for twelve hours, the whole then being transferred to a water-bath heated by steam, the temperature gradually raised to 160° Fahr., the fluid strained off while still hot, and evaporated carefully as before. The product is perceptibly different from the former, being somewhat darker in colour, and containing a small but sensible proportion of gelatinous matter. The flavour and odour were similarly unexceptionable, and the tendency to absorb moisture nearly as great as in the former sample. The weight of the product bore the relation of about three per cent. to the meat employed.

3. Professor Pettenkofer's sample was prepared according to the Bavarian Pharmacopœia process, and when we first obtained it, it was very similar in colour and flavour to our own hot-water extract.

4. The South American preparation was a fair sample of what is at best a somewhat variable article. The colour is darker than our own, the amount of gelatine notably larger, and neither the smell nor taste at all equal to those above enumerated.

5. The only sample imported from Australia which we have at present seen is similar to the South American, but not equal to it in point of flavour and colour, having a muddy appearance, and contains, as we shall presently have to observe, a large proportion of gelatinous matter.

6. That prepared by Messrs. Harvey and Reynolds is in point of flavour and general character very similar to the specimen we have described from Munich, and leaves little to be desired as a commercial article.

7. Messrs. Gillon and Co.'s extract is worthy of note as a fairly satisfactory sample, but we have been somewhat disappointed in its microscopical reactions.

8. The extract of meat lozenges we have little to say about, further than what was stated at the last meeting of Conference by one of us, though we shall adduce afterwards some confirmatory observations.

In making these remarks it is our object not to intrude commercial or personal considerations, nor, further than is necessary with a scientific end, to institute comparisons between the various manufacturers. The names of the two British houses which we have introduced have been selected as producing samples of excellence—a number of other specimens of home manufacture which have come under our notice of varying degrees of goodness or badness being omitted, inasmuch as no good end would be answered by criticism upon them.

We may now proceed to consider the chemical constituents of flesh extract, and these may be classed under two heads, inorganic and organic. The inorganic matter consists of alkaline (or earthy?) phosphates and chlorides, principally phosphate of potash and chloride of potassium. If phosphate of magnesia be present, as stated by some authors, we believe it to exist in extremely small proportions, though it is quite possible that ammonia may occur as the base of a phosphoric acid compound. The organic portions of the extract exist as kreatine, possibly kreatinine, and the colloid or gelatinous extractive. Lactic acid probably exists in some proportion in combination with one or other of the bases referred to. We shall confine our attention to such of the salts and principles we have above named whose presence may be readily recognised, and may be regarded as essential constituents of a well-made extract, especially to phosphate of potash, chloride of potassium, kreatine, and colloids.

Acid orthophosphate of potash (tribasic)

$$PO_5 \begin{cases} KO \\ 2HO \end{cases}$$

is readily soluble in water, insoluble in alcohol, the crystals taking the form of prisms with obliquely wedge-shaped ends, together with modifications of that form. It is a beautiful object under the microscope, and most brilliant when viewed by polarised light.

Chloride of potassium (KCl) exists in considerable quantities in extractum carnis, but from its extreme solubility in water is never conspicuous in microscopic preparations of the extract itself.

In order to observe the influence of extractive matter on the mode in which the crystals are deposited, a small quantity of vegetable extractive was added to a saturated alcoholic solution of the chloride, which was then allowed to evaporate spontaneously. The characters of the crystals under the different conditions are remarkably uniform, varying chiefly in size.

It is more soluble in water than common salt, scarcely at all soluble in absolute alcohol.

It crystallises in cubes, often prismatically elongated when formed slowly, but when more rapidly deposited on glass from a thin film of water, it takes the form of minute square plates, commonly aggregating in fours, or spreading into arborescent groups.

Belonging to the cubical system, it is not affected by polarised light, and may thus be distinguished from the phosphates, kreatine, and the other organic salts of extractum carnis.

Kreatine ($C_8N_3H_9O_4+2HO$) is one of the most abundant, as it is certainly the most important, of the crystalline bodies present in meat extract, so far as our knowledge at present extends. In the pure state it exists in prismatic crystals, modified variously into rectangular plates and parallelopipeds (?).

It is a neutral base, soluble in hot water, less so in cold, and sparingly soluble in alcohol. The appearance of the crystals, when viewed with polarised light, is remarkably beautiful.

Another crystalline body was observed by us, the nature of which we have not entirely made out. A portion of the meat solution made with cold water having been evaporated to the consistence of weak syrup was allowed to stand for about thirty-six hours in a porcelain basin. On removing it the surface of the porcelain was found coated with adherent, rather solid crystals, which on examination were found similar in many respects to kreatine, but differing somewhat from any specimens of that base which we have seen. Whether these be kreatine modified by the nature of the medium from which they are deposited, or whether, as we think possible, kreatinine in combination with an acid (phosphoric ?), we are scarcely prepared to say. On ignition the crystals left a scarcely perceptible residue, but as the quantity obtained was not sufficient for analysis, we have not thought it worth while to figure the salt.

The question of the existence of ammoniacal salts in the juice of flesh is one upon which we are not prepared to enter; we may, however, incidentally note that in a certain state of the evaporation—that is, at about the time when the fluid reaches the consistence of syrup—a certain amount of ammonia or other amines is invariably evolved, and the osmazome (roast meat) flavour is developed. We have thought it possible that this may be due to the splitting up of an ammoniacal phosphate. It is somewhat remarkable that during this evolution the fluid itself preserves an acid reaction.

We have endeavoured, by means of Professor Graham's process of dialysis, to determine the relative proportion of crystalloid and colloid bodies present in some of the samples operated upon. How much these may vary may be gathered from our notes on two of the specimens named. 250 grains of our preparation made with cold water yielded 18·58 grains of colloid, about 7½ per cent. of the whole weight. It is right to state that that prepared with hot water contained a much larger proportion. The Australian extract yielded from 250 grains no less than 97 grains, or nearly 39 per cent. of colloids. As these represent two extremes in quality, and our other experiments correspond with the indication they give, we may justly infer that dialysis affords a fair means of ascertaining the proximate value of commercial extracts. The diffusate on evaporation yielded a light brown residue on evaporation, which was a completely solid mass of crystals.

To obtain a further clue to the nature of the crystalloids, as they appear under the microscope, and in some measure to separate them, we have taken advantage of the different solubilities of the salts in alcohol. Portions of several of the extracts were digested in strong alcohol for some weeks, the alcoholic solutions decanted and evaporated to extract consistence. The remarkable differences which presented themselves in the various examples we shall have occasion to comment upon.

We look upon this, or indeed upon any other process by which the separation in any degree of one principle from another can be effected, as a most important matter, for the resemblance between the crystalline forms of some of the constituents proper to well-prepared extracts is so great as to make it at times a matter of extreme difficulty, depending even more upon experience and judgment than upon actual chemical data, to discriminate with certainty amongst them. We need not wish a better instance of this ambiguity than that afforded by the two most important constituents of ext. carnis, namely, kreatine and phosphate of potash. It would be exceedingly difficult to describe the forms assumed by these two bodies in their various modifications, in terms which would not apply almost equally to either; and though a little practice and observation would enable a microscopist to distinguish between them in most cases, we can scarcely help feeling the want of some more positive, if it be only to carry conviction to others. We have, since the greater portion of this paper was written, accidentally alighted upon a fact which may possibly be of value in this way. About a year ago, to avoid some trifling difficulties of manipulation, subsequently overcome by other means, we mounted a series of specimens of extract, having previously mixed them with a little pure glycerine, and set them aside without much intention of again referring to them; we have, however, on examining them, obtained an item of knowledge which may be of considerable service. The appearance the slides now present is that of an even film of brown extractive with a few large crystals here and there, evidently all of them of the same chemical nature. By subsequent experiment we have found that kreatine is soluble to a considerable extent in glycerine, and we therefore conclude the crystals in question to be those of phosphate of potash. Want of time has prevented our experimenting further in this direction, but the subject merits the attention of future observers.

We are now in position to speak of the actual appearances under the microscope of some of the specimens we have examined.

The conclusions to be drawn from our observations are as follows:—First, that, premising an accurate knowledge has been first obtained of the nature of the appearances of a reliable sample, the microscope does afford a ready means of ascertaining proximately the value of extractum carnis—the sensible characters, such as colour, taste, and odour, having been, as a matter of course, considered in the first place, and due weight assigned to them.

Secondly, that the value of a sample is in direct relationship to its crystalloids, and inversely to its colloid constituents, and these may be separated by the process of dialysis. In connexion with this we may state that the hygroscopic properties of the extract bear some relation to the amount of crystalloids contained in the samples, as we have found the specimens containing the most gelatinous matter keep their consistence best when freely exposed to the air; but of course the rate of deliquescence depends on the state of the atmosphere.

Finally, we must acknowledge the kind assistance of Dr. Attfield while making our experiments in dialysis, and of our friend Mr. A. Freire-Marreco for many hints in connexion with the purely chemical part of the subject.

On the Spirit Value of a few Purchased Tinctures, by* John Attfield, *Ph.D., F.C.S., Director of the Laboratory of the Pharmaceutical Society.*

The value of the spirit in a specimen of a tincture or other spirituous preparation depends upon the nature and amount of that spirit. The standard of excellence in this respect is, for us, the British Pharmacopœia. According to that book, every tincture should be made with spirit composed of pure ethylic alcohol and water, either in the proportion of eighty-four parts, by weight, of the former, to sixteen of the latter (rectified spirit), or of forty-nine parts of the alcohol to fifty-one of the water (proof spirit). The spirit containing 16 per cent. of water is a common article of commerce; that containing 49 per cent. of water is ordered to be made by mixing one hundred volumes of the strong spirit with sixty of pure distilled water. These, at all events, are the proportions of spirit and water with which the proof-spirit tinctures of the British Pharmacopœia are directed to be made. But there can obviously be no objection to making proof-spirit by diluting with water rectified spirit of any other strength than that just referred to—than the "sixty over proof" (60° O.P.), as it is commonly and very conveniently termed. Thus, one hundred fluid ounces of a spirit of "seventy over proof" may have seventy ounces of water added, or the same quantity of a spirit of "fifty over proof" may have fifty ounces added. In either or any other similar case the result will be the true proof-spirit of the British Pharmacopœia. These statements may appear trite, but they are made to show that there can be no excuse for the manufacture of tinctures of inferior spirituous strength, a practice which, it is to be feared, is but too common. Of twelve specimens of proof-spirit tinctures recently purchased in different parts of the country and sent to me for examination, not one contained the right proportion of spirit. On being distilled to dryness, they all furnished distillates having specific gravities below that of proof-spirit. The following table shows the strength of each specimen as indicated by the above process:—

Name of tincture.	Initials of vendor.	Quantity sold for 4d.	Alcohol in 100 parts.
"Tincture of rhubarb" .	B. & M.	1 fl. oz.	41°
,, ,, .	P. W.	1 ,,	36·5
,, ,, .	E. C. L.	2 ,,	44·5
"Laudanum" . .	P. W.	1¼ ,,	33·5
,, . .	J. Al.	1¼ ,,	41°
,, . .	B. & M.	1½ ,,	34°
,, . .	H. & Q.	2 ,,	34°
,, . .	J.		41°
"Paregoric elixir" .	B. & M.	1½ ,,	39°
,, . ,, .	P. W.	1½ ,,	45·5
"Paregoric elixir" .	E. C. L.	1½ ,,	39°
,, . ,, .	J. Al.	2 ,,	45·5
Proof spirit, B. P.			49°
Rectified spirit, B. P.			84°

From this table it is evident that only three of the twelve contained an amount of alcohol even approaching that of proof-spirit. And even those, instead of 49 per cent., contained but 44½, and two 45½. Five varied from 39 to 41 per cent. The remaining four contained only 36½, two 34 and 33⅓ respectively.

In confirmation of the evidence afforded by the above figures, that the weaker tinctures are frequently made with spirit of inferior strength, several makers have admitted to me that they always mix their rectified spirit and water in the proportion of five to four, a few five to five. One of the latter actually seemed to be under the impression that rectified spirit was the same thing as alcohol, and that as proof-spirit contained forty-nine of alcohol to fifty-one of water, he only saved a little trouble, and at the same time gave the public a slight benefit, by mixing fifty with fifty, "half-and-half" as he termed it. It had not occurred to this individual that in adding (say) fifty fluid ounces of rectified spirit to the same quantity of water, he was mixing only forty-two ounces, by weight, of the spirit, with fifty ounces, by weight, of water; and that, moreover, the said spirit already containing six and three-quarter ounces of water, his ninety-two ounces, by weight, of mixture only contained about thirty-five ounces, by weight, of alcohol; that, in short, instead of having a diluted spirit containing 50 or even 49 per cent. of alcohol, he was using one containing only about 38 (38·3), and this in the face of the plain statement of the Pharmacopœia that proof-spirit is made from rectified spirit and water in the proportion of five pints to three.

With regard to the nature of the alcohol in these specimens of tinctures, it was in nine cases purely ethylic; the other three contained methylic alcohol. The presence of the latter was indicated by Tuck's iodohydrargyride of potassium, confirmed by Miller's oxidation tests. The three methylated tinctures came from one shop, that of P. W. It is unnecessary to make any remark concerning these three adulterated preparations; the extensive use of methylated spirit in the manufacture of tinctures is well known, the determination of the Legislature to stop the practice will probably be soon equally well known.

The price at which these tinctures were supplied, varies, surely, to an unnecessary extent? Two appear to have been sold at the rate of fourpence per ounce, three at about threepence, three at about twopence halfpenny, and three at twopence per ounce. I have before me a retail price list, published in 1865, apparently, by an important and influential "Committee," but having no name, address, or other distinguishing mark, except a trade price one—"Mel Boracis," in which laudanum is marked at sixpence per ounce, and paregoric and tincture of rhubarb each at fivepence per ounce. The laudanum of the above specimens was only twopence or threepence per ounce, the paregoric twopence or twopence halfpenny, and the tincture of rhubarb twopence per ounce in one case, and fourpence in the others. Knowing but little of such matters, I would simply draw the attention of chemists and druggists to this point; manifestly, however, great inconsistency exists.

In conclusion, I would remark, that the results of the examination of these tinctures must not be taken as indicating the general practice of the trade concerning

* Read before the Pharmaceutical Conference, Nottingham meeting.

the manufacture and sale of such preparations. Pharmacies could be mentioned in which only spirit of the officinal strength and quality is used, and where fairly remunerative prices for articles of best quality are readily obtained. It would be equally unfair, however, to name the vendors of good, as of bad articles, mere accident bringing their wares under my notice. Doubtless the honest or fortunate are not more honest or fortunate, nor the dishonest or unfortunate more dishonest or unfortunate, than hundreds of their brethren whose preparations do not chance to come under the scrutiny of the analyst.

17, Bloomsbury Square, London.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION.

Friday, June 8, 1866.

On the Source of Muscular Power, by Edward Frankland, *Ph.D., F.R.S., Professor of Chemistry, R.I.*

What is the source of muscular power? Twenty years ago, if this question had been asked, there were but few philosophers who would have hesitated to reply, "The source of muscular power is that peculiar force which is developed by living animals, and which we term the vital force;" but the progress of scientific discovery has rendered the view implied in such an answer so utterly untenable that, at the present moment, no one possessing any knowledge of physical science would venture to return such a reply. We now know that an animal, however high its organisation may be, can no more generate an amount of force capable of moving a grain of sand, than a stone can fall upwards or a locomotive drive a train without fuel. All that such an animal can do is to liberate that store of force, or potential energy, which is locked up in its food. It is the chemical change which food suffers in the body of an animal that liberates the previously pent-up forces of that food, which now make their appearance in the form of actual energy—as heat and mechanical motion.

From food, and food alone, comes the matter of which the animal body is built up; and from food alone come all the different kinds of physical force which an animal is capable of manifesting.

The two chief forms of force thus manifested are heat and muscular motion or mechanical work, and these have been almost universally traced to two distinct sources—the heat to the oxidation of the food, and the mechanical work to the oxidation of the muscles.

This doctrine, first promulgated, the speaker believed, by Liebig, occupies a prominent position in that philosopher's justly celebrated "Chemico-Physiological Essays."

In his work entitled "Die organische Chemie in ihrer Anwendung auf Physiologie und Pathologie" (Brunswick, 1842), Liebig says, "All experience teaches that there is only one source of mechanical power in the organism, and this source is the transformation of the living parts of the body into lifeless compounds. This transformation occurs in consequence of the combination of oxygen with the substance of the living parts of the body." And again, in his "Letters on Chemistry" (1851, p. 366), referring to these living parts of the body, he says, "All these organised tissues, all the parts which in any way manifest force in the body are derived from the albumen of the blood; all the albumen of the blood is derived from the plastic or sanguineous constituents of the food, whether animal or vegetable. It is clear, therefore, that the plastic constituents of food, the ultimate source of which is the vegetable kingdom, are the conditions essential to all production or manifestation of force, to all these effects which the animal organism produces by means of its organs of sense, thought, and motion." And again, at page 374, he says, "The sulphurised and nitrogenous constituents of food determine the continuance of the manifestations of force; the non-nitrogenous serve to produce heat. The former are the builders of organs and organised structures, and the producers of force; the latter support the respiratory process, they are materials for respiration."

This doctrine has since been treated as an almost self-evident truth in most physiological text-books; it has been quite recently supported by Ranke;* and, in his lecture "On the Food of Man in relation to his Useful Work," 1865, Playfair says, page 37, "From the considerations which have preceded, we consider Liebig amply justified in viewing the non-nitrogenous portions of food as mere heat-givers; . . while we have been led to the conclusion that the transformation of the tissues is the source of dynamical power in the animal." At page 30 he also says, "I agree with Draper and others in considering the contraction of a muscle due to a disintegration of its particles, and its relaxation to their restoration. . . All these facts prove that transformation of the muscle through the agency of oxygen is the condition of muscular action." Finally, in a masterly review of the present relations of chemistry to animal life, published in March last,† Odling says, page 98, "Seeing, then, that muscular exertion is really dependent upon muscular oxidation, we have to consider what should be the products, and what the value of this oxidation." And again, page 103, "The slow oxidation of so much carbon and hydrogen in the human body, therefore, will always produce its due amount of heat, or an equivalent in some other form of energy; for while the latent force liberated by the combustion of the carbon and hydrogen of fat is expressed solely in the form of heat, the combustion of an equal quantity of the carbon and hydrogen of voluntary muscle is expressed chiefly in the form of motion."

Nevertheless, this view of the origin of muscular power has not escaped challenge. Immediately after its first promulgation, Dr. J. R. Mayer wrote,‡ "A muscle is only an apparatus by means of which the transformation of force is effected, but it is not the material by the chemical change of which mechanical work is produced." He showed that the 15 lbs. of dry muscles of a man weighing 150 lbs. would, if their mechanical work were due to their chemical change, be completely oxidised in 80 days, the heart itself in 8 days, and the ventricles of the heart in 2½ days. After endeavouring to prove by physiological arguments that not one per cent. of the oxygen absorbed in the lungs could possibly come into contact with the substance of the muscles, Mayer says, "The fire-place in which this combustion goes on is the interior of the blood-vessels; the blood, however—a slowly burning liquid—is the oil in the flame of life. . . Just as a plant-leaf transforms a given mechanical effect, light, into another force, chemical difference, so does the muscle produce mechanical work at the cost of the chemical difference consumed in its capillaries. Heat can neither replace the sun's rays for the plant, nor the chemical process in the animal; every act of motion in an animal is attended by the consumption of oxygen and the production of carbonic acid and water; every muscle to which atmospheric oxygen does not gain access ceases to perform its functions."

But Mayer was not the first to conceive this view of muscular action. Nearly 200 years ago, a Bath physician, Dr. John Mayow,§ distinctly stated that for the production of muscular motion two things are necessary—the conveyance of combustible substances to the muscle by

* "Tetanus eine physiologische Studie." Leipzig: 1865.

† "Lectures on Animal Chemistry."

‡ "Die organische Bewegung in ihrem Zusammenhange mit dem Stoffwechsel." 1845.

§ "De Motu musculari." 1681. Mayow was born in 1645, and died 1679.

the blood, and the access of oxygen by respiration. He concluded that the chief combustible substance so used was fat. A century before Priestley isolated oxygen, Mayow was aware of its existence in the air, in nitre, and in nitric acid; he knew that combustion is supported by the oxygen of the air, and that this gas is absorbed in the lungs by the blood, and is absolutely necessary for muscular activity.

For two decades this doctrine sank into oblivion; and it is only within the last two years that it has been again advanced, chiefly by Haidenhain,‖ Traube, and, to a limited extent, by Donders.¶

Experimental evidence was, however, still wanting to give permanent vitality to the resuscitated doctrine; for although the laborious and remarkable investigations of Voit ** and of Edward Smith †† point unmistakably in the direction of Mayow and Mayer's hypothesis, yet the results of these physiologists were not sufficiently conclusive to render the opposite view untenable. This want of data of a sufficiently conclusive character has been supplied by a happily conceived experiment undertaken by Fick and Wislicenus in the autumn of last year, and described in the *Philosophical Magazine*, vol. xxxi. p. 485. In the application of these data, however, to the problem now under consideration, one important link was found to be wanting, viz., the amount of actual energy generated by the oxidation of a given weight of muscle in the human body. Fick and Wislicenus refer to this missing link in the following words:—"The question now arises what quantity of heat is generated when muscle is burnt to the products in which its constituent elements leave the human body through the lungs and kidneys. At present, unfortunately, there are not the experimental data required to give an accurate answer to this important question, for neither the heat of combustion of muscle nor of the nitrogenous residue (urea) of muscle is known." Owing to the want of these data, the numerical results of the experiment of Fick and Wislicenus are rendered less conclusive against the hypothesis of muscle combustion than they otherwise would have been, whilst similar determinations, which have been made by Edward Smith, Haughton, Playfair, and others, are even liable to a total misinterpretation from the same cause.

The speaker stated that he had supplied this want by the calorimetrical determination of the actual energy evolved by the combustion of muscle and of urea in oxygen. Availing himself of these data, he then proceeded to the consideration of the problem to be solved, the present condition of which might be thus summed up:—It is agreed on all hands that muscular power is derived exclusively from the mutual chemical action of the food and atmospheric oxygen; but opinions differ as to whether that food must first be converted into the actual organised substance of the muscle, before its oxidation can give rise to mechanical force, or whether it is not also possible that muscular work may be derived from the oxidation of the food, which has only arrived at the condition of blood and not of organised muscular tissue.

The importance of this problem can scarcely be overrated; it is a corner-stone of the physiological edifice, and the key to the phenomena of the nutrition of animals. For its satisfactory solution the following data require to be determined:—

1st. The amount of force or actual energy generated by the oxidation of a given amount of muscle in the body.

2nd. The amount of mechanical force exerted by the muscles of the body during a given time.

3rd. The quantity of muscle oxidised in the body during the same time.

If the total amount of force involved in muscular action, as measured by the mechanical work performed, be greater than that which could possibly be generated by the quantity of muscle oxidised during the same time, it necessarily follows that the power of the muscles is not derived exclusively from the oxidation of their own substance.

As regards the first datum to be determined, it is necessary to agree upon some unit for the measurement of mechanical force. The unit most commonly adopted is that represented by the lifting of a kilogram weight to the height of one metre. The researches of Joule and Mayer have connected this standard unit with heat;—they prove that the force required to elevate this weight 425 times will, when converted into heat, raise the temperature of an equal weight of water 1° C. If this weight were let fall from a height of 425 metres, its collision with the earth would produce an amount of heat sufficient to raise the temperature of 1 kilogram of water 1° C. The same heating effect would also of course be produced by the fall of 425 kilograms through 1 metre. This standard of force is termed a metrekilogram;‡‡ and 425 metrekilograms are equal to that amount of heat which is necessary to raise the temperature of 1 kilogram of water through 1° C. If then it be found that the heat evolved by the combustion of a certain weight of charcoal or muscle, for instance, raises the temperature of 1 kilogram of water through 1° C., this means, when translated into mechanical power, 425 metrekilograms. Again, if a man weighing 64 kilograms climbs to a height of 1,000 metres, the ascent of his body to this height represents 64,000 metrekilograms of work; that is, the labour necessary to raise a kilogram weight to the height of 1 metre 64,000 times.

In order to estimate the amount of actual energy generated by the oxidation of a given amount of muscle in the body, it is necessary to determine, first, the amount of actual energy generated by the combustion of that amount of muscle in oxygen, and then to deduct from the number thus obtained the amount of energy still remaining in the products of the oxidation of this quantity of muscle which leave the body. Of these products, urea and uric and hippuric acids are the only ones in appreciable quantity which still retain potential energy on leaving the body, and of these the two latter are excreted in such small proportions that they may be considered as urea without introducing any material error into the results.

These determinations were made in Lewis Thompson's calorimeter, which consists of a copper tube to contain a mixture of chlorate of potash with the combustible substance, and which can be enclosed in a kind of diving-bell, also of copper, and so lowered to the bottom of a suitable vessel containing a known quantity (2 litres) of water. The determinations were made with this instrument in the following manner:—19·5 grams of chlorate of potash, to which about $\frac{1}{5}$th of peroxide of manganese was added, was intimately mixed with a known weight (generally about 2 grams) of the substance whose potential energy was to be determined, and the mixture being then placed in the copper tube above mentioned, a small piece of cotton thread previously steeped in chlorate of potash and dried was inserted in the mixture. The temperature of the water in the calorimeter was now carefully ascertained by a delicate thermometer; and the end of the cotton thread being ignited the tube with its contents was placed in the copper bell and lowered to the bottom of the water. As soon as the combustion reached the mixture a stream of gases issued from numerous small openings at the lower edge of the bell, and rose to the surface of the water—a height of about 10 inches.

‖ "Mechanische Leistung Wärmeentwickelung und Stoffumsatz bei der Muskelthätigkeit." 1864.

¶ As this is passing through the press, the speaker has become aware that Messrs. Lawes and Gilbert advocated this doctrine in 1852, and repeatedly since, their opinions being founded upon experiments on the feeding of cattle.

** "Untersuchungen über den Einfluss des Kochsalzes, des Kaffeés und der Muskel-bewegungen auf den Stoffwechsel," p. 150. Munich: 1860.

†† *Phil. Trans.*, 1861, p. 747.

‡‡ I follow the example of the Registrar-General in abbreviating the French word *gramme* to gram.

At the termination of the deflagration, the water was allowed free access to the interior of the bell, by opening a stopcock connected with the bell by a small tube rising above the surface of the water in the calorimeter. The gases in the interior of the bell were thus displaced by the incumbent column of water, and by moving the bell up and down repeatedly a perfect equilibrium of temperature throughout the entire mass of water was quickly established. The temperature of the water was again carefully observed, and the difference between this and the previous observation determines the calorific power or potential energy, expressed as heat, of the substance consumed.

The value thus obtained is, however, obviously subject to the following corrections :—

1. The amount of heat absorbed by the calorimeter and apparatus employed, to be added.

2. The amount of heat carried away by the escaping gases, after issuing from the water, to be added.

3. The amount of heat due to the decomposition of the chlorate of potash employed, to be deducted.

4. The amount of heat equivalent to the work performed by the gases generated in overcoming the pressure of the atmosphere, to be added.

Although the errors due to these causes to some extent neutralise each other, there is still an outstanding balance of sufficient importance to require that the necessary corrections should be carefully attended to.

The amount of error from the first cause was once for all experimentally determined, and was added to the increase of temperature observed in each experiment.

The amount of heat carried away by the escaping gases after issuing from the water may be divided into two items, viz. :—

a. The amount of heat rendered latent by the water which is carried off by the gases in the form of vapour.

b. The amount of heat carried off by these gases by reason of their temperature being above that of the water from which they issue.

It was ascertained that a stream of dry air when passed through the water of the calorimeter, at about the same rate and for the same period of time as the gaseous products of combustion, depressed the temperature of the water by only 0·02° C.

By placing a delicate thermometer in the escaping gases, and another in the water, no appreciable difference of temperature could be observed. Both these items may, therefore, be safely neglected.

The two remaining corrections can be best considered together, since a single careful determination eliminates both. When a combustible substance is burnt in gaseous oxygen, the conditions are essentially different from those which obtain when the same substance is consumed at the expense of the combined or solid oxygen of chlorate of potash. In the first case the products of combustion, when cooled to the temperature of the water in the calorimeter, occupy less space than the substances concerned in the combustion, and no part of the energy developed is therefore expended in external work, that is, in overcoming the pressure of the atmosphere. In the second case, both the combustible and the supporter of combustion are in the solid condition, whilst a considerable proportion of the products of combustion are gases. The generation of the latter cannot take place without the performance of external work, for every cubic inch produced must obviously, in overcoming atmospheric pressure, perform an amount of work equivalent, in round numbers, to the lifting of a weight of 15 lbs. to the height of one inch. In performing this work the gases are cooled, and consequently less heat is communicated to the water of the calorimeter. Nevertheless, the loss of heat due to this cause is but small. Under the actual conditions of the experiments detailed below, its amount would only have increased the temperature of the water in the calorimeter by 0·07° C. Even this slight error is entirely eliminated by the final correction which we have now to consider.

(To be continued.)

ACADEMY OF SCIENCES.

September 3.

M. Leon Foucault read a paper "*On a Means of Weakening the Intensity of the Sun's Rays at the Focus of Telescopic Object Glasses.*" This has hitherto been done either by placing a dark glass before the eyepiece, by cutting off some of the area of the object glass by means of a diaphragm, or by lowering the intensity of the rays by polarising them, and then viewing through an analyser. All these plans are imperfect, and the latter two injure the optical perfection of the instrument. M. Foucault now proposes to deposit a layer of metallic silver on the outer surface of the object glass, by the means he has already so successfully adopted for silvering the concave glasses for reflecting telescopes. The metallic coating, whilst it possesses so brilliant a lustre, has also a transparency and limpidity which is comparable to the finest coloured glass ; and as it may be regarded as a surface devoid of thickness, its addition to the object glass will not interfere with the accuracy of its surface. By its means the instrument is protected against the heat of the solar rays, which are almost entirely reflected back towards the sky, whilst a minute quantity of blue light only penetrates through the metal, and is refracted in the ordinary manner, and forms at the focus a steady and clear image which can be observed without injury to the observer's sight. The contour of the solar disk is projected sharply against a black sky, the spots are marked with precision, and the faculæ, as well as the decrease of light towards the edge of the sun, are distinctly shown. The true colour of the sun is a little altered, owing to the preponderance of blue rays ; but the gradations of intensity are well preserved, so that no detail is lost, whilst the eye after a short time becomes accustomed to the blueness, and does not observe it. The only drawback appears to be that this plan necessitates the sacrifice of an instrument, at least for a time, and the question appears to be, Is the object to be gained worth the cost? M. Foucault thinks that it is.

Two papers "*On the Silkworm Disease*" were given respectively by M. F. E. Guérin-Méneville and M. A. Béchamp. The former considers that he has demonstrated that the diseases are of two kinds, one caused by too much acidity, and the other by too much alkalinity, in the blood of the worms, arising from errors of nourishment. M. Béchamp's communication was in the form of a reply to some observations made by M. Pasteur on a former note of the author's, and was followed, as a matter of course, by a counter reply from M. Pasteur.

M. André Sanson read a paper "*On the Characteristics of Race.*" M. C. Grad sent a note "*On the Rainfall in Alsace and the Vosges.*" M. Ch. Ste-Claire Deville read a letter which he had received from M. G. Delenda, and in which it was stated that the volcanic phenomena were still active at Santorin.

M. J. M. Philipeaux sent a paper, in which he shows that the spleen cut out of young mammiferous animals and then immediately replaced in the abdominal cavity will adhere and continue to live and develope. The last paper read was by M. J. Kunckel, "*On the Organs of Secretion in Insects of the Order of Hemiptera.*"

NOTICES OF BOOKS.

The Inductorium, or Induction Coil. By Henry M. Noad, Ph.D., F.R.S. London : Churchills.

It gives us pleasure to draw attention to this useful little volume. It has been written at the request of, and for Mr. Ladd, the well-known scientific instrument-maker,

and supplies a want which has long been felt—that of a work which can be placed in the hands of persons possessing or desiring to possess an induction coil, a clear and succinct account of the electrical principles on which the instrument is constructed, with a description of the most beautiful series of experiments illustrative of the phenomena of the induced current. One thing about the book which deserves credit is, that there is no attempt at hiding its real character. It is a very legitimate, indeed praiseworthy, advertisement of Mr. Ladd's instruments, and the author has very properly not attempted to conceal this fact from his readers. The scientific position of Dr. Noad, and the authority with which he speaks as the author of one of the most popular series of lectures on electricity, are sufficient guarantee that the advertisement direct never degenerates into the puff oblique.

Those who have had the pleasure of witnessing the experiments with Mr. Atkinson's magnificent coil, containg nearly 70 miles of wire in the secondary helix, and giving sparks nineteen inches long, will be glad to find in this work a description of the construction of this and other large instruments, with full details as to the precautions necessary when experimenting with them.

It is known to most of our readers that both Hofmann and Buff have employed the spark current from the induction coil for the decomposition of gaseous compounds; in this way cyanogen, nitrous oxide, nitric oxide, carbonic acid, marsh gas, olefiant gas, sulphuretted and phosphuretted hydrogen, have been decomposed with results which show what a powerful, elegant, and useful agent of gaseous analysis the induction coil is likely to become.

The author quotes a description of an experiment tried by Mr. J. Barrett. It is a modification of Grove's fine experiment with phosphorus, by which he first discovered the stratifications in the electrical discharges *in vacuo*. After the tube is exhausted and supplied with phosphorus vapour, the connexion is made with the coil and the commutator turned on. On continuing to work the extra barrel of the sir-pump, the light will become wider and fill the whole tube; the stream of electricity will assume a faint salmon colour, the stratifications becoming still more brilliant, until the colour becomes white or silver, and the effect, to a close observer, gorgeous in the extreme. The author continues:—

"Sometimes the effect produced is that of a number of cones of light chasing each other from below upwards and *vice versâ*; sometimes they are flat tables of light, an inch or more apart; sometimes they are rings, apparently revolving or oscillating, and vanishing one into the other, and not unfrequently the whole mass assumes the form of a cloud with no motion whatever; sometimes there are two clouds, and the effect of intercepting the current for a minute or so is to bring back the stratification, which lasts but for a very short time, and the cloud remains as before, resisting all endeavours to produce stratification, except for two or three seconds after the current is turned on. A very common effect is the formation of one large column of little cones in rapid motion, filling the whole tube, and reminding one of the ripple of the sea by moonlight; and, again, four or five streams of cones filling the tube from end to end all at the same time. On more than one occasion, after varying the effects for upwards of an hour, I have succeeded in obtaining from sixteen to twenty layers of stratification, each layer being composed of two colours distinctly divided in the centre, the upper half green, the lower magenta, and *vice versâ* according to the directions of the current."

The work is filled with engravings showing the various forms of luminous discharges and stratifications in vacuum tubes, and a description of the spectra of the light from the different gas vacua, with the best methods of observation, are also given. Although not part of the book proper, readers will find the price list, with references to the figures in the text, which is bound up with the book, very useful.

The kind of work of which this is an illustration is somewhat novel. Mr. Griffin has published one or two of a similar class, and we think, if leading manufacturers were to follow this example more generally, a great boon would be conferred upon the younger students of science.

Handbook of Natural Philosophy. By Dionysius Lardner, D.C.L.—*Electricity, Magnetism, and Acoustics.* Revised and Edited by G. C. Foster, B.A. London: Walton and Maberly.

Dr. Lardner's introductions to elementary physica are so well known that it will merely be necessary for us to draw attention to the present volume, which has been added to and brought down to the present state of knowledge by Mr. Foster. The object of the book is not so much to afford minute and detailed information to the scientific man, as to supply in a convenient, portable, and well-arranged form an accurate knowledge of the present state of physical science, with special application of its various branches to the industrial arts and to the practical business of life.

The changes which the editor has made have been very considerable. Thus, in Book II. the new matter added includes Ohm's law of the intensity of currents, the tangent galvanometer, the measurement of conducting powers, the rheostat, ozone, the polarisation of electrodes, the retardation of telegraphic signals by inductive action in submarine cables, and the laws of the development of heat in the voltaic circuit. Additions almost as great have been made in the other books of which the volume is composed.

Zeitschrift für Chemie, &c., Nos. 13 and 14. 1866.

The papers in No. 13 are the following:—"On Picric Ether," by Drs. Muller and Stenhouse; "On Oxypicric Ether," by Dr. Stenhouse; "On some Resins," by H. Hlasiwetz and L. Barth; "On Atropin," by W. Lossen; "On some Compounds of Cobalt and Nickel with Nitrous Acid," by O. L. Erdmann; "On the Separation of Zirconia from Titanic Acid and some other Substances," by R. Hermann; "On the Composition of Tschewkinite," by R. Hermann; "On Compounds of Magnesium and Calcium with Aluminium," by F. Wöhler; "On Vapour Densities," by H. Ste-Claire Deville and A. Cahours; "On the Action of Sodium on Camphor, and the Bodies formed thereby," by H. Baubigny; "On the Formation of some Compounds by long-continued Reactions," by Becquerel; "On the Ingredients of Senna Leaves," by Dragendorff and Kubly; "On Acetate of Albumen," by J. C. Lehmann; "On Albuminous Urine," by the same author; "On Fumarin," by G. Preuss; "Composition of the Water of the Dead Sea and surrounding Springs," by A. Terreil; "On the Behaviour of Lead towards Water," by Stahlmann; and "On the Occurrence of Leucin and Tyrosin in Healthy Bodies," by S. Radziejewsky. Most of these papers it will be seen that we have already noticed. In the paper "On Senna Leaves," the authors state that the active principle is an acid to which they have given the name *Cathartic acid*, and they mention that they have obtained a very similar, if not identical, compound from rhubarb and buckthorn. We shall give the process for obtaining the acid from senna in a future number. Cathartic acid is a glucoside which, under the influence of an acid, splits up into glucose and cathartogenic acid. The other ingredients mentioned are chrysophanic acid, senna-picrin, senna-crol, and a saccharine substance which the authors have named catharto-mannite.

With regard to albuminous urine, Lehmann states that carbonic acid produces in such urine a precipitate of globulin. He also confirms the opinion that the acid reaction

of urine is not owing to free acid, but to the presence of an acid salt—acid phosphate of soda. In the paper "On the Behaviour of Lead to Water," Stahlmann states—what, by the way, is well known—that the presence of some salts—nitrates, for example, and ammonia—rather promotes the action. He states also that a piece of lead *standing* in a bottle of *active* water is quickly attacked at the places where it touches the glass; but if *suspended* in the water it will remain unattacked a week long.

No. 14 also contains for the most part papers we have noticed. The contents of this number are as follows:—"On Sulphocyanogen Compounds," by Dr. Hermes; "On the Absorption Spectrum of Didymium," by R. Bunsen; "On Pyrophosphodiamic Acid," by Dr. Gladstone; "On the Compounds of Tantalum," by C. Marignac; "A Method of Organic Analysis," by E. H. von Baumhauer; "On the Behaviour of Pimento Oil towards Hydriodic Acid," by E. Erlenmeyer; "On the Preparation of Chlorides of Cyanogen," by A. Gautier; "On some Derivatives of Paraoxybenzoic Acid," by Ladenburg and Fitz; "On the Cinchona Alkaloids, and Estimation of Nitrogen by Soda Lime," by E. A. v. der Burg; "On the Formation of Secondary Amines of the Phenyl and Toluol Series," by De Laire, Girard, and Chapoteaut; "Remarks on Frankland and Duppa's Synthetical Researches on Ethers," by A. Geuther; "Principles in the Root of *Sarracenia purpurea*," by St. Martin; "On Ozone in the Blood," by Lewisson; "Constituents of *Lignum colubrinum*," by B. v. Berlekom; "On the Occurrence of Sugar-forming Substances in the Organs of Diabetic Patients," by M. Jaffe; "On the Specific Gravity Test for Mercurial Ointment," by G. Pile; "Does Noria Exist?" by R. Hermann; "On Asperolite," by R. Hermann; "On the Amount of Ilmenic Acid in Columbite," by R. Hermann; "On Crystallised Sulphide of Sodium," by C. Rammelsberg; "Separation of Indium from the Flue-dust of Zinc Ovens," by R. Boettger; "On Peroxide of Hydrogen," by C. Schönbein; "On the Behaviour of Glauber Salt Solutions at Low Temperatures," by Dr. Lindig; "On the Composition of Wiserin," by Dr. v. Wartha; "On Means of Dissolving Gold," by J. Nicklès; "On the Bye-Products in the Preparation of Propylene," by H. Bassett; "On the Ashes of Cantharides," by Kubly; "On a Moist Way of Extracting Quicksilver," by R. Wagner; "On the Colouring Matters of Fluor Spar," by G. Wyrouboff; and "On the Detection of Alkaloids," by R. Wagner.

NOTICES OF PATENTS.

Patent for the Use of Carbolate of Soda.

Our attention has been drawn to the fact that in 1861 M. Bobœuf took out a patent for the employment of an alkaline solution of carbolic acid as a new hæmostatic and antiseptic agent; in the patent, No. 2441, he gives full directions for preparing a solution of carbolate of soda, and the specification, which M. Bobœuf has forwarded to us, is so worded as to include a mixture of any of the tar acids in any alkaline solution. This preparation, for which the patentee obtained the Montyon prize awarded by the French Institute, has a large sale in France, but the fact of its being patented in England appears to be quite unknown. A bottle of the preparation has been forwarded to us; it contains about half a pint of a dilute solution of carbolate of soda, and is sold retail for 1½ francs. The patentee has within the last few weeks been making inquiries in England as to whether an alkaline solution of the tar acids is sold in England for disinfecting purposes, and we believe it is his intention to protect his patent from infringement. As several firms are, to our certain knowledge, selling aqueous carbolate of soda as a disinfectant, they will thank us for this timely warning. We may mention that the only use to which M. Bobœuf proposes in the specification to apply his solution, which he calls phenate of soda (*Phénol sodique Bobœuf*) is for the purpose of stopping the flow of blood from wounds, &c., although, according to the label on the bottle, it is a cure for nearly every evil which flesh is heir to.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W. C.

1162. A. Upward, Goswell Road, Middlesex, and Honourable A. A. Cochrane, Westminster, "Improvements in the manufacture of gas."—Petition recorded April 25, 1866.

1823. J. N. Fournel, Faubourg St. Pierre, Nancy, France, "Improvements in the manufacture of iron and cast iron, and in the apparatus employed therefor."—July 11, 1866.

1940. H. A. Bonneville, Rue du Mont Thabor, Paris, "A new and improved explosive compound mixture." A communication from Baron A. A. de Cantillon de Ballyhigue, and E. Cookes, Rue St. Honoré, Paris.

1948. W. Weldon, West Hill, Highgate, Middlesex, "Improvements in the manufacture of chlorine."—July 26, 1866.

1956. P. Griess, Burton-on-Trent, Staffordshire, and H. Caro, Manchester, "Improvements in the preparation of bodies in which nitrogen is substituted for hydrogen."—July 28, 1866.

1966. A. Paraf, Manchester, "The application to medicine, for beverages, and for industrial purposes, of a new gaseous water." A communication from P. Schutzenberger, Paris.

1970. J. J. Bodmer, Newport, Monmouthshire, "Improvements in the manufacture of cements, concretes, and artificial stone."—July 31, 1866.

1978. A. Paraf, Manchester, "Improvements in deoxidation and precipitation." A communication from M. Paraf-Javal, Thann, Paris.—August 1, 1866.

2025. J. Hamilton, Glasgow, N.B., "Improvements in artificial materials for producing gas for illuminating purposes."

2026. W. E. Newton, Chancery Lane, "Improvements in the manufacture of carbonates and bicarbonates of soda and potash, the soluble and insoluble silicates of soda and potash, and muriatic acid, from chlorides of sodium and potassium." A communication from H. M. Baker, J. H. Poole, and W. R. Stace, Rochester, New York, U.S.A.—August 6, 1866.

2034. J. N. Browne, Elgin Crescent, Notting Hill, Middlesex, "Improvements in preserving wood." A communication from L. Robbins, New York, U.S.A.—August 7, 1866.

2046. A. Oldroyd, Clapton, Middlesex, and P. A. Godefroy, Homerton, Middlesex, "Improvements in the treatment of jute."—August 8, 1866.

2058. L. E. Williams, Pickskill, Westchester, New York, U.S.A., "Improvements in explosive shells."—August 10, 1866.

2067. J. J. Ensley, New York, U.S.A., "An improved apparatus for manufacturing illuminating gas and producing bone black and other valuable residuum."

2068. B. F. Weatherdon, Chancery Lane, "Improvements in thermometers and pyrometers." A communication from C. Leroy and J. J. M. Durand, Route de Fontainebleau, Seine, France, and C. Pichoin, Route d'Italie, Paris.—August 11, 1866.

2072. D. Marchal, Brussels, "Improvements in the combustion and prevention of smoke, and in increasing the heating power of fuel."—August 13, 1866.

2077. S. Rowbotham, Brookside, Penketh, near Warrington, Lancashire, "Making caustic soda from common salt or chloride of sodium by the action of lead or its oxide, and afterwards recovering the lead as oxide or otherwise for use again in making caustic soda from common salt."

2083. J. A. Wanklyn, London, and A. Paraf, Manchester, "Improvements in the production of green colouring matters for dyeing and printing textile fabrics and yarns."—August 14, 1866.

2095. J. Webster, Birmingham, "Improvements in coating and recovering metals from chlorides and other solutions of metals."

2101. J. Cameron, Barrow-in-Furness, Lancashire, "Improvements in the manufacture of iron and steel."—August 15, 1866.

2107. A. Kühne, Norfolk Street, London, "Improvements in the purification of water, and in the disinfection and preservation of putreacent and putrescible matters." A communication from Dr. W. Kühne, Berlin.

2110. G. Payne, Battersea, Surrey, "Treating fatty and oily matters."—August 16, 1866.

2114. E. T. Hughes, Chancery Lane, "The application of chlorine for the condensation of nitrous gas, and improvements in the apparatus connected therewith." A communication from C. Large, Lyons, France.

2115. A. Paraf, Manchester, "Improvements in the use and application of an inorganic glyceric ether."

2119. W. Clark, Chancery Lane, "Improvements in puddling furnaces." A communication from C. de Graff Baker, J. Harlan, and J. Bell, Wheeling, Ohio, West Virginia, U.S.A.—August 17, 1866.

Notices to Proceed.

1080. C. J. B. King, M.D., Stone, Staffordshire, "A new unfermented beverage."—Petition recorded April 17, 1866.

1093. C. A. Girard, Rue des Ecoles, Paris, and G. de Laire, Rue de Sévres, Paris, "Improvements in the preparation of diphenylamine and analegous substances."—April 18, 1866.

1108. G. Lunge, Ph.D., South Shields, Durham, "Improvements in the manufacture of carbonates and bicarbonates of soda and potash."

1116. J. Leigh, Manchester, "Improvements in the purification of coal gas."—April 20, 1866.

1162. A. Upward, Goswell-road, Middlesex, and Honourable A. A. Cochrane, Westminster, "Improvements in the manufacture of gas."

1163. G. E. Noone, Hastings, Sussex, "Improvements in machinery and processes for deodorising and treating sewage and other refuse, and manufacturing therefrom manure and other substances for chemical and other uses."—April 25, 1866.

1173. W. Edmond and A. Gwilt, Swansea, Glamorganshire, "Improvements in furnaces and apparatus for separating heated gases, fumes, or vapours from each other, and from solid or liquid bodies."

1174. A. Paraf, Manchester, "Improvements in printing and dyeing textile fabrics and yarns."—April 26, 1866.

1207. A. V. Newton, Chancery Lane, "Improvements in the manufacture of steel." A communication from E. L. Bomeisler, Philadelphia, Penn., U.S.A.

1209. W. P. Piggott, Argyle Street, Regent Street, Middlesex, "Improvements in preventing corrosion and fouling of iron ships."—April 28, 1866.

1232. J. Thomas, Battersea, Surrey, and A. Prince, Charing Cross, Middlesex, "Improvements in reverberatory blast and other furnaces for smelting oils, and in the means of extracting the precious metals therefrom."—May 1, 1866.

1470. B. F. Weatherdon, Chancery Lane, "Improvements in gas pyrometers, which may also be employed as thermometers." A communication from J. J. M. Durand, Rue de Fontainebleau, Gentilly, Seine, France, and C. Pichoin, Rue d'Italie, Paris.—May 26, 1866.

1938. W. E. Newton, Chancery Lane, "Improvements in treating iron for the purpose of converting it into steel or hard metal, and for plating or coating and hardening and tempering iron and steel." A communication from E. Savage, West Meriden, Conn., U.S.A.—July 25, 1866.

CORRESPONDENCE.

On the Proposed Doubling of the Received Chemical Formulæ.

To the Editor of the Chemical News.

Sir,—I have just read Mr. Newlands' second paper "On Certain Reasons for Doubling or otherwise Multiplying Chemical Formulæ;" and though the subject has necessarily lost some of its freshness from the length of time that has elapsed since the publication of that paper, I cannot let his strictures on my reply to his first paper pass without comment, inasmuch as he seems to have totally misapprehended my meaning. Prolonged absence on a tour must be my apology for not having answered his remarks earlier.

Mr. Newlands says that, because I state that his theory is, *a priori*, as likely to be true as any other, and then go on to remark that the presumption is in favour of the older and simpler formulæ, and that the burden of proof lies with him, I appear to possess information upon a subject on which one of the most illustrious of our modern chemists has not hesitated to plead his ignorance. Now, I lay no claim to the possession of any more information than that within Dr. Hofmann's or any other chemist's reach. Let us hear what an able writer says:—"A presumption in favour of any supposition means, not (as has been sometimes erroneously imagined) a preponderance of probability in its favour, but such a *pre-occupation* of the ground as implies that it must stand good till some sufficient reason is adduced against it; in short, that the *burden of proof* lies on the side of him who would dispute it."* I meant, and, I think, expressed, neither more nor less than this *logical* presumption; and it is, in my opinion, unfair of my opponent thus to wrest my use of the word in its usual sense, and to make it appear as if I spoke of probability. There is a wide difference between a presumption and a probability.

As I do not accept Mr. Newlands' definition of an atom, and as I am able to conceive that atoms have different sizes, his doubt as to my ability to conceive that one atom can occupy the same space as two atoms (of a different kind) has no weight.

I regret that, by a clerical error, when speaking of the vapours of NH_4Cl and PCl_5, I spoke of "those compounds" instead of "those other compounds," and thus fairly laid myself open to my opponent's charge of having misapprehended him. The sentence, as quoted by him betwixt inverted commas, is altered, and "those" changed into "these." By thus misquoting me, he converts, what would have appeared to most in its true character, into a great blunder, and one involving gross ignorance of two well-known vapour densities.

In replying to my question—what is the quantivalence of carbon in C_2H_8, &c.?—Mr. Newlands has entirely suppressed the second and conjoint question I there put—Can these (new atomicities) be assigned to C, N, and O in substitution compounds?—but refers me to a paper of his in the Chemical News of May 18, 1866. With this paper I was previously unacquainted; but, having perused it, I find no answer to the second and most important of the above questions; and we must hence assume that Mr. Newlands' hypothesis is devoid of that experimental confirmation which we might reasonably expect to find. I may here remark that were Mr. Newlands' hypothesis accepted, and our received formulæ multiplied by any number whatever, the theory of atomicity would practically become valueless. I am not writing in support of that theory, but merely wish to point out to what this chemist's views would lead.

Again, when he says that, in speaking of carbon exchanging two affinities, and being at least quinquivalent,

* Whately's Rhetoric, Pt. I., ch. iii., sect. 2.

I evidently mean that the two atoms of carbon interchange one affinity, I reply just so; and will add that, in my humble opinion, one expression is as correct as the other. I am willing to acknowledge that I stand open to correction; but I used the term advisedly, and so worded it that it scarcely needed Mr. Newlands' explanation to render it intelligible to the readers of the Chemical News. I leave it to be decided by the balance of opinion whether, when two affinities of two atoms, one from each atom, mutually saturate each other, it be more correct to say that they exchange two affinities, or that they interchange one affinity. Here, again, Mr. Newlands has misquoted me, though the words he has imported into my sentence do not materially affect its sense.—I am, &c.,

Thomas Stevenson, M.D. Lond.

Laboratory, Guy's Hospital, Sept. 6, 1866.

MISCELLANEOUS.

Medicinal Preparations of Carbolic Acid.—We published in our last number an account of a death occasioned by drinking carbolic acid, and several instances have been brought before our notice of injury having been occasioned by the incautious use of this powerful antiseptic. Some of this inconvenience has been caused by the fact that the only available article readily obtainable by the public has been the acid itself in its concentrated form. Our attention has recently been directed to some carbolic acid lozenges, which are said to possess singularly efficacious properties. Their flavour is not too powerful to prevent their being used under circumstances where the antiseptic properties of carbolic acid are required internally, whilst they are sufficiently biting on the tongue to prevent their being consumed as a sweetmeat should the bottle containing them get into the hands of children, young or old. When carbolic acid is required for medicinal use, we think that these lozenges will afford a particularly convenient means of its administration.

Preservation of Meat by means of Paraffin.—Amongst the objects exhibited at the *soirées* and the Pharmaceutical Conference during the meeting of the British Association at Nottingham, few things attracted more attention than sundry amorphous-looking lumps, covered with a white coating, like twelfth-cakes in an incipient stage of manufacture. Labels told the visitors that one of these was a mutton chop, another a loin of mutton, a third a airloin of beef, preserved by Redwood's process. This process has already been briefly described in our pages. It consists in the immersion of fresh meat in melted paraffin, at a temperature of 240° Fahr., for a sufficient time to effect a concentration of the juices of the meat and the complete expulsion of air; after which the meat, in its condensed state, is covered with an external coating of paraffin, by which air is excluded and decomposition prevented. The concentration of the juices may thus be carried to any required extent. If the meat is to be kept in hot climates, its weight should be reduced by evaporation to about one-half, in which state it will contain all the nutriment of twice its weight of fresh meat, the portion driven off by evaporation consisting only of water. Thus prepared it will be fully cooked (by the heat applied in the process), and it may not only be eaten without further preparation, but it will also be applicable for the preparation of a variety of made dishes, including stews, hashes, soups, gravies, &c. . For cold climates a less amount of heating and concentration will suffice, so that the meat may retain its original juicy condition, and, when further cooked, present the appearance, and possess all the characters, of fresh unpreserved meat. The paraffin used in the process is perfectly innocuous, free from taste and smell, and is not subject to change from keeping. It may be removed from the surface of the meat by putting the latter into a vessel containing boiling water, when the paraffin as it melts will rise to the surface of the water, and may be taken off in a solid cake when cold, while, at the same time, the meat will become softened and prepared for cooking in any suitable way. Among the advantages claimed for the process may be mentioned its great simplicity, the facility with which it can be performed by unskilled workmen, and its inexpensive character, as the same paraffin can be used for an indefinite number of times, and the quantity required for coating the meat is very small. When the meat is concentrated, as described for hot climates, it is rendered very portable, and no special care is required in packing it. Samples of meat preserved by this process have been tested by the method adopted by Messrs. Gillon and Co., of Leith, the well-known preserved provision merchants, with perfectly satisfactory results. Messrs. Gillon have found from long experience that if the meat can be kept in a hot room at a temperature of about 100° Fahr. for eight or ten days without change, it will keep for lengthened periods in any climate, and they are accustomed to submit their preserved provisions to this method of testing before sending them out. The samples were seventeen days in the testing hot-room, and, judging from experience, Messrs. Gillon are confident that they would remain good in any climate, even in the tropics.

Chemistry and Physiology.—It is quite clear that what we call chemistry, with its attendants, heat and electricity, plays a most important part in the animal machine; and, probably, more information as to the nature of the organic processes is to be expected from their chemical study than in any other way. We have found out that there is a very close relation between a complete atomic formula and the vital processes, the amount of chemical tension which is expressed by the former being commensurate with the character of the latter, and the amount of chemical change which takes place in the textures being commensurate with the activity of the vital processes. There seems good reason to believe that a muscular fibre is the container of a given amount of chemical force compressed by the medium of a high chemical formula, and existing, therefore, in a high state of tension; that during its construction the compressed force is set free by the decomposition of its structure—that is, by the resolution of its component elements, chiefly by a process of oxidation, to a lower formula or a state of lower tension, at the same time that heat is evolved and electrical changes take place; though the latter are not yet distinctly defined. It is impossible, therefore, to avoid the application here of the doctrine of contractile force, which is being so clearly worked out in the inorganic world, and which seems to be the greatest advance that has for some time been made in our knowledge of the laws of matter. We can scarcely doubt that the chemical force which is set free during the decomposition attendant upon muscular action is the equivalent of the contractile force that is evinced and of the heat that is evolved. In other words, a muscle may be regarded as the medium by which force is accumulated, rendered latent, or condensed in a condition of high chemical tension, and is, from time to time, as occasion may require, set free and converted into muscular or contractile force and heat. It seems probable that such is the case, and we may look for the more clear demonstration of it, with some confidence, as a real gain to physiology, inasmuch as certain of the animal formations will be thus withdrawn from the mysterious region of life into the more intelligible domain of science.—*From the Inaugural Address of Professor Humphry, in Section D. British Association, Nottingham Meeting.*

ANSWERS TO CORRESPONDENTS.

Randleson and Forster.—The degrees are Centigrade.

Thomas W. B.—A series of articles by Dr. Lionel Beale on Microscopic Researches on Cholera is in course of publication in the *Medical Times and Gazette.*

Books Received.—The Technologist, for September.

WATER-GLASS, or SOLUBLE SILICATES of Soda and Potash, in large or small quantities, and either solid or in solution, at ROBERT RUMNEY'S Ardwick Chemical Works, Manchester.

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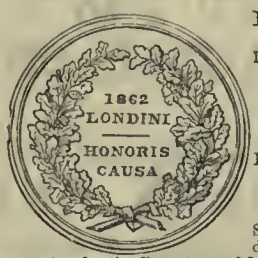

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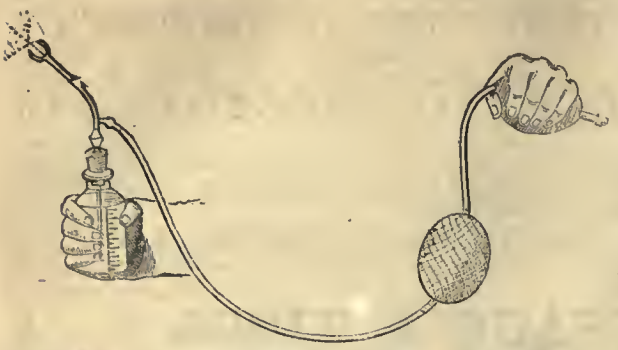

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THE

CHEMICAL NEWS

AND

Journal of Physical Science.

Edited by] [*Wm. Crookes, F.R.S.*

No. 355.] *Registered for* Friday, September 21, 1866. *Transmission abroad.* {PRICE 4*d*. POST FREE, 5*d*.

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Sept. 17.

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Physicians—Dr. Farre, Dr. Jeaffreson, Dr. Black, and Dr. Martin.
Consulting Surgeons—Mr. Skey and Mr. Lawrence.
Surgeons—Mr. Wormald, Mr. Paget, Mr. Coote, and Mr. Holden.
Assistant-Physicians—Dr. Edwards, Dr. Harris, Dr. Andrew, and Dr. Southey.
Assistant-Surgeons—Mr. Savory, Mr. Callender, Mr. T. Smith, and Mr. Willett.
Physician-Accoucheur—Dr. Greenhalgh.

LECTURES.

Medicine—Dr. Black.
Clinical Medicine—Dr. Farre, Dr. Black, and Dr. Martin.
Surgery—Mr. Paget and Mr. Coote.
Clinical Surgery—Mr. Skey, Mr. Paget, Mr. Coote, and Mr. Holden.
Descriptive Anatomy—Mr. Holden and Mr. Callender.
Physiology and General Anatomy—Mr. Savory.
Chemistry—Dr. Odling.
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Demonstrator of Morbid Anatomy—Dr. Andrew.
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SUMMER SESSION, commencing MAY 1st, 1867.

Materia Medica—Dr. Farre.
Botany—Rev. George Henslow.
Forensic Medicine—Dr. Edwards.
Midwifery—Dr. Greenhalgh.
Comparative Anatomy—Dr. Church.
Practical Chemistry—Dr. Odling.
Dental Surgery—Mr. Coleman.
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Introductory Lecture by Professor Hallen, November 1st, at 4 p.m.

The Course of Education for the ensuing Session will be conducted as follows:—

LECTURES.

Hippopathology—Mr. Hallen, V.S.
Anatomy—Mr. Strangways, V.S.
Physiology—Dr. P. Young.
Chemistry—Dr Dalzell.
Veterinary Materia Medica—Dr. Dalzell.
Cattle Pathology—Mr. Strangways, V.S.
Anatomical Demonstrations by the Professor of Anatomy.
Practical Chemistry by Dr. Dalzell; and
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Lord Rector—Earl RUSSELL, K.G., LL.D.
Vice-Chancellor and Principal—P. C. CAMPBELL, D.D.

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WINTER SESSION, commencing on the first Tuesday of November.

Anatomy—Professor Struthers, M.D. 11 a.m. Class fee, £3 3s.
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Chemistry—Professor Brazier. 3 p.m. £3 3s.
Institutes of Medicine—Professor Ogilvie, M.D. 4 p.m. £3 3s.
Surgery—Professor Pirrie, C.M., F.R.S.E. 10 a.m. £3 3s.
Practice of Medicine—Professor Macrobin, M.D. 2 p.m. £3 3s.
Midwifery and Diseases of Women and Children—Professor Dyce, M.D. 4 p.m. £3 3s.
Zoology, with Comparative Anatomy—Professor Nicol, F.R.S.E., F.G.S. 2 p.m. £3 3s.
Medical Logic and Medical Jurisprudence—Professor Ogston, M.D. 9 a.m. £3 3s.

SUMMER SESSION, commencing on the first Monday of May.

Botany—Professor Dickie, M.D. 8 a.m. £3 3s.
Materia Medica (100 Lectures)—Professor Harvey, M.D. 10 and 3. £3 3s.
Zoology and Comparative Anatomy—Professor Nicol. 11 a.m. £3 3s.
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DISINFECTION AND THE CHOLERA.

From an apathy in regard to sanitary matters which is almost culpable, the public mind appears to be in some danger of falling into the opposite extreme. Not very long ago the objects sought to be gained by disinfection were so little understood, that the employment of one of the best and most scientific disinfectants was officially condemned, by high Government authorities, on the ground that it would encourage dirt and foster habits of uncleanliness; and it has only been by the irresistible force of the lessons taught by two great public calamities, that the opinion is gaining ground, that disinfection does not always mean chloride of lime *usque ad nauseam*.

The striking results which attended the antiseptic method of cattle plague disinfection, and the successful manner in which the principles laid down on that occasion for the combating of zymotic poisons have since been applied to the treatment of cholera, have caused "disinfection" to become a household word; and there is every reason to hope that what is now used only as a word, will, before long, become the representative of a correct idea.

Disinfection is by no means so simple a process as is generally supposed. We cannot use one substance with equal efficacy in all imaginable cases. The process is one depending upon complicated chemical and physiological actions, and chemistry has placed at our disposal several substances which are applicable to the various requirements of the case; but to pin one's faith to one agent only, be it carbolic acid, chloride of lime, Condy's fluid, or McDougall's powder, is to limit one's powers of disinfection in a very unwise degree; whilst to recommend all these things, without discriminating in what cases they are severally to be used, is like sending a sick man to a druggist's shop, telling him neither what special drug to take nor how much for a dose.

It is highly important that the best plan of disinfection adapted to the present or like emergencies should be definitely settled by some competent authority, and its adoption then made imperative throughout the country. The various disinfectants ought always to supplement each other, so that when the contents of the adjacent sewers blend together, the purifying action of the disinfectants used should pervade the mass.

At present, however, owing to the want of accurate knowledge of the laws of disinfection, and the absence of combined action between the local self-governing authorities, the contrary result obtains. For instance, during the late outbreak of cholera, in the parishes of Putney, St. Giles, St. Luke's, Fulham, Wandsworth, and others, chloride of lime was preferred. In Clerkenwell, Condy's fluid was used; in St. Marylebone, St. George's (Hanover Square), Holborn, and others, carbolic acid and McDougall's power were employed; whilst in St. Pancras the height of absurdity was attained, and the authorities deluged the same sewers on alternate days with oxidising and with deoxidising agents.

Thus, the drainage of one thousand acres, saturated with a powerfully *oxidising* disinfectant, mingles in the sewers with the drainage from another thousand acres, to which a powerfully *deoxidising* agent has been applied with equal liberality; so that when the streams of sewage from these districts meet, the several agents exert reciprocally an antagonistic action, thus expending their energies in mutual destruction instead of uniting them in serviceable work.

The infected sewage of a parish expends but a small portion only of its baneful action in that parish. Its disinfection, therefore, concerns all districts of London, whose health is thus at the mercy of any vestry or local board who may choose to entertain heterodox views on the subject.

ORGANIC MATTER IN WATER.

It is interesting to compare the amount of organic matter in some of the Cumberland lakes, whence Messrs. Hemans and Hassard propose to obtain the future water supply of London, with the organic matter existing in the water already supplied to the metropolis. According to Mr. Way, the grains of organic matter per gallon is in

River Lowther	0·62
Haweswater	0·62
Ullswater	0·35
Thirlmere	0·77

giving an average of 0·59 grains.

According to Dr. Letheby, the grains of organic matter per gallon is in the

Grand Junction Waterworks	0·60
West Middlesex	0·48
Southwark and Vauxhall	0·64
Chelsea	0·56
Kent	0·03
New River	0·22
East London	0·56

showing an average of 0·44 grains; or a balance against Cumberland of 0·15 grains of organic matter per gallon.

It must, however, be borne in mind that in judging of organic matter *quality* rather than *quantity* must be looked at. The organic matter in the English lakes is principally derived from the peaty vegetation on the mountain sides, and is non-nitrogenous and comparatively harmless; whilst London organic matter is likely to consist chiefly of nitrogenised sewage.

It would greatly increase the value of the analyses of London waters, which Drs. Frankland and Letheby periodically publish, were they accompanied with a column giving the amount of *nitrogen* (other than ammoniacal) in the organic matter present.

It is not improbable that a simple relation would be seen to exist between the quantity of nitrogen and the prevalence of cholera or other pestilence.

The Atlantic Telegraph.—The New York *Independent* gives the following:—"On Monday, July 30, Mr. Field received a message of congratulation from Mr. Ferdinand de Lesseps, the projector of the Suez Canal. It was dated at Alexandria, in Egypt, the same day, at half-past one p.m., and received in Newfoundland at half-past ten a.m. Let us look at the globe, and see over what a space that message flew. It came from the land of the Pharaohs and the Ptolemies—it passed along the shores of Africa, and under the Mediterranean ocean, more than a thousand miles, to Malta—it then leaped to the continent of Europe and shot across Italy, over the Alps and through France, under the English Channel, to London—it then flashed across England and Ireland, till from the cliffs of Valentia it struck straight into the Atlantic, darting down the submarine mountain which lies off the coast, and over all the hills and valleys which lie beneath the watery plain, resting not till it touched the shore of the 'New World.' In that morning's flight it had passed over *one-fourth* of the earth's surface, and so far outstripped the sun in his course that *it reached its destination three hours before it was sent!* To understand this, it must be remembered that the earth revolves from west to east, and when it is sunrise here it is between eight and nine o'clock in Alexandria, in Egypt, and when it is sunset here it is nearly nine o'clock in the evening there."

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Part III.

Connexion between Organic and Inorganic Chemistry.

Section IV.—*Inorganic and Organic Chlorides, Bromides, &c.*

In the preceding pages we have made apparent the analogies of structure and even of reactions that exist between the organic oxides, hydrates, and ethers, and the inorganic oxides, hydrates, and salts. These analogies may be traced in other classes of compounds. We have already compared the inorganic with the organic chlorides. Let us confine ourselves to this short remark, that it is not a question here of purely symbolic relations, but that the analogies expressed by the typical formulæ are founded upon the similitude of the reactions. Let us compare, in this respect, the chloride of sulphuryl with the chloride of succinyl. Both chlorides contain a radical of a bibasic acid. Both are decomposed in the same way under the influence of water, the one forming sulphuric acid, the other succinic acid.

$$\underset{\text{Chloride of sulphuryl.}}{SO_2,Cl_2} + \left.\begin{matrix}H_2\\H_2\end{matrix}\right\}O_2 = \underset{\text{Sulphuric acid.}}{\left.\begin{matrix}SO_3\\H_2\end{matrix}\right\}O_2} + 2HCl$$

$$\underset{\text{Chloride of succinyl.}}{C_4H_4O_2,Cl_2} + \left.\begin{matrix}H_2\\H_2\end{matrix}\right\}O_2 = \underset{\text{Succinic acid.}}{\left.\begin{matrix}C_4H_4O_2\\H_2\end{matrix}\right\}O_2} + 2HCl$$

Similarly the chlorides, bromides, and iodides of the alcohol radicals may be compared to the metallic chlorides, bromides, and iodides. The analogy of the following reactions cannot be mistaken:—

$$\underset{\text{Iodide of ethyl.}}{(C_2H_5)'I} + \underset{\text{Acetate of silver.}}{\left.\begin{matrix}C_2H_3O\\Ag\end{matrix}\right\}O} = \underset{}{AgI} + \underset{\text{Acetate of ethyl.}}{\left.\begin{matrix}C_2H_3O\\(C_2H_5)'\end{matrix}\right\}O}$$

$$\underset{\text{Iodide of potassium.}}{KI} + \left.\begin{matrix}C_2H_3O\\Ag\end{matrix}\right\}O = AgI + \underset{\text{Acetate of potassium.}}{\left.\begin{matrix}C_2H_3O\\K\end{matrix}\right\}O}$$

$$\underset{\text{Diniodide of ethylene.}}{(C_2H_4)''I_2} + 2\left[\left.\begin{matrix}C_2H_3O\\Ag\end{matrix}\right\}O\right] = 2AgI + \underset{\text{Dinacetate of ethylene.}}{2\left.\begin{matrix}(C_2H_3O)\\(C_2H_4)''\end{matrix}\right\}O_2}$$

$$\underset{\text{Iodide of calcium.}}{Ca''I_2} + 2\left[\left.\begin{matrix}C_2H_3O\\Ag\end{matrix}\right\}O\right] = 2AgI + \underset{\text{Dinacetate of calcium.}}{2\left.\begin{matrix}(C_2H_3O)\\Ca''\end{matrix}\right\}O_2}$$

It seems to me useless to insist upon these relationships, which are evident and accepted by all chemists. I will give some others that are newer and more remarkable.

There exists, independently of M. Regnault's dichloride of sulphuryl, a compound intermediate between the latter and sulphuric acid. This is chlorosulphuric acid, obtained by Dr. Williamson* by treating concentrated sulphuric acid with perchloride of phosphorus.

$$\underset{\text{Sulphuric acid.}}{\left.\begin{matrix}(SO_2)''\\H_2\end{matrix}\right\}O_2} \qquad \underset{\text{Chlorosulphuric acid. (Sulphuric chlorhydrine.)}}{\left.\begin{matrix}(SO_2)''\\H\\Cl\end{matrix}\right\}O} \qquad \underset{\text{Dichloride of sulphuryl.}}{(SO_2)''Cl_2}$$

Chlorosuccinic acid—

$$\left.\begin{matrix}(C_4H_4O_2)''\\H\\Cl\end{matrix}\right\}O$$

corresponding to chlorosulphuric acid, has not yet been obtained, to my knowledge, although theory foresees the existence of such a compound. But in the lactic acid series we know of compounds intermediate between the dichlorides and the acids.

$$\underset{\text{Glycolic acid.}}{\left.\begin{matrix}(C_2H_2O)''\\H_2\end{matrix}\right\}O_2} \qquad \underset{\text{Chloroglycolic acid (monochloracetic).}}{\left.\begin{matrix}(C_2H_2O)''\\H\\Cl\end{matrix}\right\}O} \qquad \underset{\text{Dichloride of glycolyl.}}{(C_2H_2O)''Cl_2}$$

$$\underset{\text{Lactic acid.}}{\left.\begin{matrix}(C_3H_4O)''\\H_2\end{matrix}\right\}O_2} \qquad \underset{\text{Chlorolactic acid (monochloropropionic).}}{\left.\begin{matrix}(C_3H_4O)''\\H\\Cl\end{matrix}\right\}O} \qquad \underset{\text{Dichloride of lactyl.}}{(C_3H_4O)''Cl_2}$$

Such intermediate compounds exist also in the series of the polyatomic alcohols. The first were obtained by M. Berthelot,† who described, under the name of monochlorhydrine and dichlorhydrine, compounds intermediate between glycerine and trichloride of glyceryl (trichlorhydrine)—

$$\underset{\text{Glycerine.}}{\left.\begin{matrix}(C_3H_5)'''\\H_3\end{matrix}\right\}O_3} \qquad \underset{\text{Monochlorhydrine.}}{\left.\begin{matrix}(C_3H_5)'''\\H_2\\Cl\end{matrix}\right\}O} \qquad \underset{\text{Dichlorhydrine.}}{\left.\begin{matrix}(C_3H_5)'''\\H\\Cl_2\end{matrix}\right\}O} \qquad \underset{\text{Trichloride of glyceryl.}}{(C_3H_5)'''Cl_3}$$

With glycol I have similarly obtained an intermediate compound, which I have called chlorhydric glycol, or monochlorhydrine of glycol.

There are some metallic compounds which possess an analogous constitution, and which may be considered as intermediate between the hydrates and the chlorides, bromides, and fluorides.

Berzelius has described, under the name of oxyfluoride of copper, a well crystallised body, whose composition he expressed by the formula $CuFl,CuO,HO$. If we adopt for oxygen and copper, atomic weights double their equivalents, this formula becomes—

$$Cu''O.HFl.$$

Fluorhydrate of oxide of copper.

Now, it is easy to see that there exist between hydrate of copper, fluoride of copper, and this body, the same relations as those which exist between chlorhydric glycol, glycol, and chloride of ethylene.

$$\underset{\text{Hydrate of copper.}}{\left.\begin{matrix}Cu''\\H_2\end{matrix}\right\}O_2} \qquad \underset{\text{Cupric monofluorhydrine.}}{\left.\begin{matrix}Cu''\\H\\Fl\end{matrix}\right\}O,} \qquad \underset{\text{Cupric difluoride.}}{Cu''Fl_2}$$

$$\underset{\text{Glycol.}}{\left.\begin{matrix}(C_2H_4)''\\H_2\end{matrix}\right\}O_2} \qquad \underset{\text{Monochlorhydric glycol.}}{\left.\begin{matrix}(C_2H_4)''\\H\\Cl\end{matrix}\right\}O} \qquad \underset{\text{Ethyleuic dichloride.}}{(C_2H_4)''Cl_2}$$

M. Debray‡ observed this important fact, that when molybdic acid is heated in a current of hydrochloric acid gas to 150° or 200°, it forms a white, crystalline, and very volatile substance. This is a chlorhydrate of molybdic acid, the composition of which he expresses by the formula MoO_3,HCl. I look upon this body as being a molybdic chlorhydrine, and I should define in the following manner its connexion with molybdic hydrate. Molybdenum may be considered as hexatomic in molybdic acid

$$MoO_3.$$

* *Annales de Chimie et de Physique*, 3rd series, vol. xli., p. 486.

† *Annales de Chimie et de Physique*, 3rd series, vol. xli., p. 296.

‡ *Comptes-Rendus*, vol. xlvi, p. 1093.

Normal molybdic hydrate would be—

$$\left.\begin{matrix}Mo^{vi}\\H_6\end{matrix}\right\}O_6.\S$$

M. Debray described the first anhydride of this normal hydrate, viz., the dihydrate—

$$\left.\begin{matrix}Mo^{vi}\\H_4\end{matrix}\right\}O_5.\|$$

The molybdic chlorhydrine, described by M. Debray, is derived from this dihydrate—

$$\left.\begin{matrix}Mo^{vi}\\H_4\end{matrix}\right\}O_5, \qquad \left.\begin{matrix}Mo^{vi}\\H_2\end{matrix}\right\}O_3 \quad Cl_2.$$

Molybdic dihydrate. Molybdic dichlorhydrine.

We may similarly consider the fluoxytungstates of M. Marignac. This chemist has described a fluoxytungstate of ammonia,¶ the composition of which he represents in equivalents by the formula—

$$NH_4,WO_2Fl_2.$$

In our notation, adopting for tungsten the atomic weight 184, this formula becomes—

$$2(NH_4)WO_2Fl_4.$$

The substance in question forms, according to M. Friedel, a tungstic fluorhydrine—

$$\left.\begin{matrix}W^{vi}\\(NH_4)_2\end{matrix}\right\}O_2 \quad Fl_4$$

derived from the hydrate—

$$\left.\begin{matrix}W^{vi}\\H_6\end{matrix}\right\}O_6.$$

As to the other fluoxytungstates described by M. Marignac, they are derived from a ditungstic hydrate.

There are chromic chlorhydrines and ferric chlorhydrines. In an important article, M. H. Schiff** justly remarked that the hydrated oxychlorides of chromium, obtained by M. Moberg by the desiccation of the hydrated perchloride, are derived from chromic hydrate by the substitution of several atoms of chlorine for several groups of HO.

$$\left.\begin{matrix}Cr_2\\H_6\end{matrix}\right\}O_6, \quad \left.\begin{matrix}Cr_2\\H_4\end{matrix}\right\}O_4\ Cl_2 \quad \left.\begin{matrix}Cr_2\\H_2\end{matrix}\right\}O_2\ Cl_4 \quad \left.\begin{matrix}Cr_2\\H\end{matrix}\right\}O+4aq.\ Cl_5 \quad Cr_2Cl_6$$

Chromic hydrate. Chromic dichlorhydrine. Chromic tetrachlorhydrine. Chromic pentachlorhydrine. Chromic chloride.

We know, on the other hand, that ferric hydrate dissolves freely in a solution of ferric chloride. The oxychlorides which are thus formed, and to which M. Béchamp†† has called attention, are doubtless ferric chlorhydrines, or rather mixtures of ferric chlorhydrines.

Metastannic hydrate dissolves in hydrochloric acid, and the solution thus obtained differs notably, according to H. Rose,‡‡ from the aqueous solution of stannic chloride. We may, in fact, imagine that by the action of hydrochloric acid upon metastannic hydrate there may be formed polystannic chlorhydrines (see page 61).

Condensed chlorhydrines exist, derived from the polyethylenic or polyglyceric alcohols. Thus diethylenic alcohol may give birth to two derived bodies of this class, viz.:—

$$\left.\begin{matrix}C_2H_4\\C_2H_4\\H_2\end{matrix}\right\}O_2 \qquad \left.\begin{matrix}C_2H_4\\C_2H_4\\H\\Cl\end{matrix}\right\}O_2 \qquad \left.\begin{matrix}C_2H_4\\C_2H_4\end{matrix}\right\}O\ Cl_2$$

Diethylenic alcohol. Monochlorhydrine of diethylenic alcohol. Dichlorhydrine of diethylenic alcohol.

The second may be looked upon as a combination of oxide of ethylene and of chloride of ethylene. By heating for a long time bromide of ethylene with oxide of ethylene, I obtained a small quantity of a bromised liquid whose composition was sensibly that of a bromoxide of ethylene.§§

$$C_2H_4Br_2+2C_2H_4O=\left.\begin{matrix}C_2H_4\\C_2H_4\\C_2H_4\\Br_2\end{matrix}\right\}O_2$$

The chlorides or bromides of oxides of inorganic chemistry have a constitution analogous to that of this latter body. The following examples will make this analogy evident.

Hydrate of lime dissolves in a solution of chloride of calcium, and the alkaline liquid properly concentrated deposits on cooling hydrated crystals, to which H. Rose assigns the composition,

$$3CaO,CaCl+16HO.$$

In our notation this formula becomes—

$$3CaO,CaCl_2+16aq.\|\|\|$$

and may be written—

$$\left.\begin{matrix}Ca\\Ca\\Ca\\Ca\\Cl_2\end{matrix}\right\}O_3+16\text{ aq. analogous to }\left.\begin{matrix}C_2H_4\\C_2H_4\\C_2H_4\\C_2H_4\\Cl_2\end{matrix}\right\}O_3$$

Dichlorhydrine of tetrethylenic alcohol.

There are oxychlorides of lead possessing an analogous constitution. Thus *mendipite*, which is a well crystallised mineral, contains—

$$2PbO.PbCl_2=\left.\begin{matrix}Pb_3\\Cl_2\end{matrix}\right\}O_2$$

Atacamite is an oxychloride of hydrate of copper, the composition of which is expressed in equivalents by the formula—

$$CuCl+3CuO+HO.$$

By adopting for copper an atomic weight double the equivalent, this formula becomes—

$$\left.\begin{matrix}2Cu''\\H\\Cl\end{matrix}\right\}O_2 \text{ derived from the hydrate } \left.\begin{matrix}2Cu''\\H_2\end{matrix}\right\}O_3.$$

Dicuprie monochlorhydrine.

(To be continued.)

§ Mo = 96.

‖ MoO_3+2HO in the old notation.

¶ *Annales de Chimie et de Physique*, 3rd series, vol. lxix., p. 66.

** *Ibid.*, 3rd series, vol. lxvi., p. 142, October, 1862.

†† *Ibid.*, vol. lvii., p. 286.

‡‡ Poggendorff's *Annalen*, vol. cv., p. 564.

§§ *Annales de Chimie et de Physique*, vol. lxix., p. 342.

‖‖ aq. $= H_2O$.

PHARMACY, TOXICOLOGY, &c.

On a New Macerating Apparatus, by Mr.* R. W. GILES.

THE unostentatious arrangement exhibited before the Conference, for the more convenient exhaustion of vegetable substances in a minimum quantity of water, having proved very satisfactory in the preparation of infusum cinchonæ spissatum, and other allied liquors of ordinary and extensive use in pharmacy, I have thought it worthy of a few remarks at the present meeting. I do not desire to see pharmaceutical chemists become manufacturers, but I strongly believe that the natural mode of advancing the practice of pharmacy amongst the many in our profession is to give them a practical interest in the processes of the art, beginning

* Read before the Pharmaceutical Conference, Nottingham meeting.

with the most simple; and that the communication of simple forms of apparatus which will have the advantage of rendering ordinary processes easy and profitable, is one of the best means of attaining this object. I may take this opportunity of saying that the establishment of a Museum of Pharmacentical Apparatus at Bloomsbury Square has long been an object of solicitude to me; and I trust that the present exhibition may ultimately result in such an institution, which we may hereafter consult with advantage and economy, and the origin of which we may pleasantly associate with this our agreeable visit to Nottingham.

The apparatus needs little description to those who have seen the model. It consists of a series of eight cone-shaped maceratora, each provided with its receiver, and the water used for maceration is passed successively through the material divided amongst the eight cones—the material being reduced to a convenient state of pulverisation, and each maceration being continued for such periods (varying from one hour to twelve hours) as may be appropriate to the character of the particular substance treated.

The advantage of this arrangement is that—with little more water than is required to moisten the whole—each of the eight portions receives eight successive macerations, which is sufficient to exhaust even such stubborn materials as cinchona bark. Other substances are exhausted with greater facility, and, of course, require a correspondingly smaller quantity of water. If it is said that a similar result may be attained by a process of percolation in a single vessel, I can only reply that I shall be obliged to any gentleman who will teach me how to avoid the practical difficulties of accomplishing this. I have utterly failed to do so, and out of these failures and by successive steps I have arrived at the present expedient, which, according to my experience, leaves nothing to be desired.

I regret that I cannot submit a satisfactory table of results obtained from the arrangement in the form in which it is now recommended, as, unfortunately, I find they have not been recorded. I can, however, give the results obtained from an intermediate apparatus, consisting of four maceratora only. I hope to substitute a more complete table at some future meeting.

Twenty-four pounds cort. cinchonæ cord., divided into four portions, and macerated successively, gave:—

		Sp. gr.	Different density.
1st maceration,	10 pints.	1021·8	
2nd ,,	12 ,,	1012·3	9·5
3rd ,,	12 ,,	1008·3	4·0
4th ,,	11 ,,	1005·6	2·7
5th ,,	10 ,,	1004·0	1·6
6th ,,	8 ,,	1003·6	0·4

On Weights, Measures, Coins, and Numbers, by* John Attfield, *Ph.D., F.C.S., Director of the Laboratory of the Pharmaceutical Society of Great Britain.*

I have been at some trouble in collecting actual specimens of metric decimal weights and measures, with allied coins, &c., for temporary display at the Exhibition of Objects relating to Pharmacy now (August, 1866) open at the Assembly Rooms, Nottingham, in connexion with the British Pharmaceutical Conference, and for more frequent reference should a similar exhibition be held annually in the towns visited by that Association.† I have done this in the hope of aiding in familiarising at least one section of the community—chemists and druggists—with a system destined, without doubt, at no distant period to displace the present barbarous confusion of weights, measures, and coins in use in this country. For, though habit prevents us from fully and constantly realising the inconveniences attending the use of existing weights and measures, their incongruity with each other and with our monetary and numerical systems is none the less real.

It is now, happily, scarcely necessary to say anything in favour of the universal adoption of the metric decimal system of weights and measures and a corresponding decimal system of coinage. Most persons who have thought over the matter agree that such a proceeding would be to the immense advantage of education, labour, trade, science, and the general interests of society. Pharmaceutists have frequently indicated their desire for change from the existing inharmonious methods of weighing, measuring, buying, selling, and calculating, to a system in which either of these operations should bear a simple relation to the rest. They, in common with other people, recognise the convenience of the relation of grosses and dozens to shillings and pence, that so many sovereigns per ton must be the same number of shillings per hundredweight, &c., &c., and, whenever opportunity has arisen, have agreed to welcome a system which should bind weights, measures, coins, and numbers into one harmonious whole, characterised by a single relation equal in simplicity to either of the two illustrations just mentioned. Every volume of the *Pharmaceutical Journal* contains allusions to this subject in the form of reports of meetings, discussions, papers, letters, &c., and the Proceedings of our own Conference include an elaborate report on weights and measures, by Mr. Barnard S. Proctor.

What is asked of chemists and druggists is to aid in promoting the general adoption of a system of weights, measures, and coins which shall be in accord with the existing universal system of numbers. It is, perhaps, impossible to realise, much more express, the advantages we enjoy from the fact that in every country of the world the system of numeration is identical. That system is a decimal one. There are those who tell us an octavial would have been more convenient, but the universality of the decimal method of counting must obtain for it unquestioned preference. Whatever language a man speaks, his method of numbering is decimal; his talk concerning number is decimal; his written or printed signs signifying number are decimal. With the figures 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, he represents all possible variation in number, the position of a figure in reference to its companions alone determining its value, a figure on the left hand of any other figure in an allocation of numerat symbols (for example, 1866) having ten times the value of that figure, while the figure on the right hand of any other has a tenth of the value of that other. When the youngest apprentice is asked how many units there are in 1866, he smiles at the simplicity of the question, and says 1866. How many tens? 186, and 6 over. How many hundreds? 18, and 66 over. How many thousands? 1, and 866 over. But if he is asked how many scruples there are in 1866 grains, how many drachms, how many ounces—he must probably bring out his slate and pencil. And so with the pints or gallons in 1866 fluid ounces, or the feet and yards in 1866 inches, or the pence, shillings, and pounds in 1866 farthings; to say nothing of cross questions, such as the value of 1866 articles at 9s. 6d. per dozen; and to say nothing of perplexity caused by

* Read before the Pharmaceutical Conference, Nottingham meeting.

† During the intervals of the yearly meetings, the collection will be open to inspection in the rooms of the Pharmaceutical Society, Bloomsbury Square, London.

the varying values of several individual weights or of measures of length, capacity, and surface in different parts of the country. What is desired, then, is that there should be an equally simple decimal relation among weights and measures and coins as already universally exists among numbers. This condition of things having already been accomplished in other countries, there is no good reason why it should not be accomplished in this. It is, doubtless, possible to decimalise our own weights, measures, and coins, but such a course would be difficult, added to which the day has passed for the consideration of such a scheme. France, Holland, Belgium, Italy, Spain, Portugal, Switzerland, Greece, and South America generally have all adopted a decimal system founded on a measure of length (about eleven-tenths of our yard) appropriately called the metre; the United States,† Austria, Prussia, Switzerland, Sweden, Norway, Denmark, and Russia give indications of adopting it sooner or later, and the same system was legalised by Act of Parliament in our own country in 1864. From the metre are derived the unit measure of weight, the gramme; the unit measure of capacity, the litre; and the unit measure of surface, the are. 1866 metres contain 186 decametres and 6 over, or one kilometre and 866 over. 1866 grammes contain 1 kilogramme and 866 over. And so on, the prefixes deca-, hecto-, kilo-, myrio-, indicating multiples, deci-, centi-, milli-, submultiples. The coins attached to the system have a similar decimal relation, and may indeed be used as metrical weights if not much worn. This metrical (*i.e.*, metre-ical) system having been adopted in every case in which change has been made, it is incumbent on us to adopt it in preference to any other decimal system.

There are, doubtless, serious difficulties attendant upon a change affecting the daily, nay hourly, transactions of every individual in a kingdom—difficulties caused even more by association than calculation, for the latter is only a matter of education, easily and quickly acquired, while it takes years to associate our requirements of articles with the quantities in which those articles can be obtained. Yet what other peoples have done the English can do. And probably, by an extension of that class of terms which are independent of all systems and compatible with any, such as a bottle of wine, a glass of beer, a round of beef, half of this, a quarter of that, a shilling's worth of one thing, a franc's worth of another, so much per cent. of a whole, the change will not prove so formidable as it appears. So far as chemists and druggists are concerned, the transition will be comparatively easy, most dispensers having made up French prescriptions, in which the quantities are metrical.

In short, the only questions which probably need be discussed in the Pharmaceutical Conference are, how and when the metric decimal system of weights and measures should be introduced into pharmacy. In the British Pharmacopœia there is a table showing the relations of the system, and in the forthcoming edition of that work we are to have an enlarged table, as well as, I believe, some additional allusions to the system. I trust that the table will include the English equivalents of the metric decimal units and multiples. It is only fair that the formidable appearance of a whole string of figures necessary to show the metric value of a pound, &c., should be balanced by the equally formidable appearance of the string of figures necessary for the indication of the English value of a kilo-, &c. If not in the next, in the third edition let us hope to see metrical equivalents of the weights, &c., given in every formula. There would be no great difficulty in doing this, as already pointed out by Mr. Squire (*Pharmaceutical Journal*, May 2, 1859); indeed, it has already been done in a former edition of a Continental Pharmacopœia.

To memorialise the Medical Council, the body under whose direction the Pharmacopœia is published, with a view to the adoption of this course; to resolve that it would be desirable to ultimately use the metric decimal system of weights and measures in pharmacy, to the exclusion of all others; and to constantly, individually, make efforts to promulgate a knowledge of the nature and advantages of the system among friends and acquaintances—are probably the only ways in which at present the members of the British Pharmaceutical Conference can aid in promoting that desirable object, a simple universal relation between weights, measures, and coins, and the existing universal system of numbers.

17, Bloomsbury Square, London.

† There is a coin of the United States in the collection 5 cents in value, 5 grammes in weight, and 2 centimetres in diameter.

On the Calamine of Pharmacy,* *by Mr.* R. H. Davis.

The subject I have undertaken to investigate for this Conference is the quality of calamine as now supplied by the ordinary class of dispensing chemists in the kingdom.

Previous examinations have shown that formerly an article so called was almost invariably composed of sulphate of baryta with small quantities of carbonate of lime and oxide of iron.

The results now placed before you will, I think, be gratifying in exhibiting a great advance in the purity of this preparation, as generally supplied by the retail druggist at this present time.

The analyses I have made of the specimens of calamine are arranged in a table, for convenience of comparison, as follows. The results obtained have been calculated for 100 grains:—

	1.	2.	3.	4.	5.	6.	7.	8.	9.
Oxide of Zinc	73·64	67·64	56·25	17·29	13·15	...	...	...	...
Peroxide of Iron	5·89	3·65	6·43	·51	·57	2·31	1·35	2·00	·90
Oxide of Copper	trace	·54	...	...	...	...	...	...	...
Carbonate of Lime	5·30	10·61	10·79	3·46	8·34	4·92	4·74	3·17	1·97
Carbonate of Magnesia	...	trace	...	...	trace	trace	trace	trace	trace
Sulphate of Baryta	...	...	...	75·56	73·19	86·03	88·69	92·99	94·66
Silica, &c.	7·05	14·95	23·33	...	...	...	...	...	...
Water	1·44	2·61	·98	1·80	1·75	1·28	·92	·88	·77
Loss	6·68	...	2·22	1·38	3·00	5·46	4·30	·96	1·70
Total	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00

* Read before the Pharmaceutical Conference, Nottingham meeting.

No. 1. Purchased in the suburbs of London. 2. From Leeds. 3. From Dr. Attfield, marked No. 10. 4. From a medicine chest, supposed to be about thirty years old. Labelled as from a well-known West-end London house. 5. From Dr. Attfield, marked No. 1. 6. From a London wholesale house, sent out, seven years since, as P. L. 7. From Newcastle. 8. From Dr. Attfield, marked No. 3. 9. From Leeds.

Mr. Challoner, of Derby, a large manufacturer of calamine, kindly communicated to me the following information respecting it:—"The native calamine is met with in Derbyshire, in porous veins twenty inches or less in thickness, and imbedded in a hard kind of sandstone (called Dawstone by the miners); frequently a vein of lead ore, and occasionally sulphate of baryta, is found attached."

Mr. Challoner concludes by saying, "The genuine is never sent except when especially ordered."

Referring to the table of analyses, Nos. 1, 2, and 3 may be considered genuine. Their appearance, as may be observed from the specimens exhibited, is not so pleasing as the salmon-coloured old-fashioned variety with which the public is conversant.

Nos. 4 and 5 are peculiar; the small quantity of oxide of iron and the comparatively large quantity of oxide of zinc found gives rise to the suspicion that they are special preparations, possibly mixtures of oxide of zinc and the barytic calamine.

Nos. 6, 7, 8, and 9 correspond, and are of the ancient quality, innocent of any admixture with the genuine preparation, and are of a kind which was once universally supplied throughout the trade. Several analyses have been made from time to time of this barytic calamine. Mr. Brett was the first person to publish an account of it.†

At a later period, David Murdoch, Esq., read a paper on this substance before the Philosophical Society of Glasgow.‡ In 1848 Mr. Edward Moore furnished analyses of six specimens of calamine obtained from the most respectable drug houses in London. With one exception they all correspond in a marked degree with Nos. 6, 7, 8, and 9 in the present table of analyses; the exceptional specimen contained 58·6 per cent. of oxide of zinc.§

In the same year Mr. Jacob Bell gave an interesting paper on the same subject,‖ in which we are informed that six specimens of calamine procured at some of the most respectable shops in Paris were examined and found to be fair specimens of calamine. The English specimens which had been obtained shortly before from the most respectable houses in London by Mr. E. Moore contrast very unfavourably with those supplied by the pharmaciens of Paris.

From the analyses now supplied, it is pleasing to note the decided improvement in the quality of the English calamine since that period, and it is to be hoped that when a future examination, after a corresponding period, is made of the calamine of pharmacy, not a single specimen of the barytic compound will be found for sale in any establishment in the kingdom.

Harrogate, August 18.

† "British Annals of Medicine," vol. i., p. 483.

‡ *Pharmaceutical Journal*, vol. iv., p. 31.

§ *Ibid.*, vol. viii., p. 70.

‖ *Ibid.*, vol. viii., p. 321.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION.

Friday, June 8, 1866.

On the Source of Muscular Power, by Edward Frankland, *Ph.D., F.R.S., Professor of Chemistry, R.I.*

(Continued from page 128.)

It is well known that the decomposition of chlorate of potash into chloride of potassium and free oxygen is attended with the evolution of heat. If a few grains of peroxide of manganese, or better, of peroxide of iron, be dropped into an ounce or two of fused chlorate of potash which is slowly disengaging oxygen, the evolution of gas immediately proceeds with great violence, and the mixture becomes visibly red hot, although the external application of heat be discontinued from the moment when the metallic peroxide is added. The latter remains unaltered at the close of the operation. It is thus obvious that chlorate of potash, on being decomposed, furnishes considerably more heat than that which is necessary to gasify the oxygen which it evolves. It was therefore necessary to determine the amount of heat thus evolved by the quantity of chlorate of potash (9·75 grams) mixed with one gram of the substance burnt in each of the following determinations. This was effected by the use of two copper tubes, the one placed within the other. The interior tube was charged with a known weight of the same mixture of chlorate of potash and peroxide of manganese as that used for the subsequent experiments, whilst the annular space between the two tubes was filled with a combustible mixture of chlorate and spermaceti, the calorific value of which had been previously ascertained. The latter mixture was ignited in the calorimeter as before, and the heat generated during its combustion effected the complete decomposition of the chlorate in the interior cylinder, as was proved by a subsequent examination of the liquid in the calorimeter, which contained no traces of undecomposed chlorate. The following are the results of five experiments thus made, expressed in units of heat, the unit being equal to 1 gram of water raised through 1° C. of temperature:—

	Units of Heat.
1st experiment.	340
2nd ,, ...	300
3rd ,, ...	375
4th ,, ...	438
5th ,, ...	438
5)1891	
Mean	378

This result was confirmed by the following experiments:—

1. Starch was burnt, firstly, in a current of oxygen gas, and secondly, by admixture with chlorate of potash and peroxide of manganese.

Heat units furnished by one gram of starch burnt with 9·75 grams chlorate of potash . . .	4290
Heat units furnished by the same weight of starch burnt in a stream of oxygen gas . . .	3964
Difference	326

2nd. Phenylic alcohol was burnt with chlorate of potash, and the result compared with the calorific value of this substance as determined by Favre and Silbermann.

Heat units furnished by one gram of phenylic alcohol burnt with 9·75 grams chlorate of potash	8183
Heat units furnished by one gram of phenylic alcohol when burnt with gaseous oxygen (Favre and Silbermann)	7842
Difference	341

These three determinations of the heat evolved by the decomposition of 9·75 grams of chlorate of potash, furnish-

ing the numbers 378, 326, and 341, agree as closely as could be expected, when it is considered that all experimental errors are necessarily thrown upon the calorific value of the chlorate of potash.

The mean of the above five experimental numbers was, in all cases, deducted from the actual values read off in the following determinations.

It was ascertained by numerous trials that all the chlorate of potash was decomposed in the deflagrations, and that but mere traces of carbonic oxide were produced.

Joule's mechanical equivalent of heat was employed, viz., 1 kilogram of water raised 1° C. = 423 metrekilograms.

The following results were obtained :—

Actual Energy developed by One Gram of each Substance when burnt in Oxygen.

Name of substance dried at 100° C.	Heat Units.					Metrekilograms of force. (Mean.)
	1st experiment.	2nd experiment.	3rd experiment.	4th experiment.	Mean.	
Beef muscle purified by repeated washing with ether. . . .	5174	5062	5195	5088	5103	2161
Purified albumen . .	5009	4987	...	...	4998	2117
Beef fat . . .	9069	...	...	...	9069	3841
Hippuric acid . .	5330	5437	...	...	5383	2280
Uric acid . . .	2645	2585	...	...	2615	1108
Urea*	2121	2302	2207	2197	2206	934

It is evident that the above determination of the actual energy developed by the combustion of muscle in oxygen represents more than the amount of actual energy produced by the oxidation of muscle within the body, because, when muscle burns in oxygen, its carbon is converted into carbonic acid, and its hydrogen into water ; the nitrogen being, to a great extent, evolved in the elementary state ; whereas, when muscle is most completely consumed in the body, the products are carbonic acid water and urea ; the whole of the nitrogen passes out of the body as urea—a substance which still retains a considerable amount of potential energy. Dry muscle and pure albumen yield, under these circumstances, almost exactly one-third of their weight of urea, and this fact, together with the above determination of the actual energy developed on the combustion of urea, enables us to deduce with certainty the amount of actual energy developed by muscle and albumen respectively when consumed in the human body. It is as follows :—

Actual Energy developed by One Gram of each Substance when consumed in the Body.

Name of substance dried at 100° C.	Heat units. (Mean.)	Metrekilograms of force. (Mean.)
Beef muscle purified by ether .	4368	1848
Purified albumen . . .	4263	1803

We have thus ascertained the first of our three data—viz., the amount of force or actual energy generated by the oxidation of a given amount of muscle in the body ; and we now proceed to ascertain the second—viz., the amount of mechanical force exerted by the muscles of the body during a given time. For this purpose we have only to avail ourselves of the details of Fick and Wislicenus's conclusive experiment already referred to, and which consisted in the ascent of the Faulhorn in Switzerland from the Lake of Brienz. This mountain can be ascended by a very steep path from Iseltwald, which was of course favourable for the experiment, and there is an hotel on the summit which allowed the experimenters to pass the following night under tolerably normal circumstances. The following is their own description and estimate of the amount of work performed in the ascent :†—

"Let us now inquire how much work was really done by our muscles. One item necessary for the reply is already at hand—viz., the height of the summit of the Faulhorn above the level of the Lake of Brienz multiplied by the weight of the body—the former reckoned in metres, the latter in kilograms. The weight of the body with the equipments (hat, clothes, stick) amounted to 66 kilograms in Fick's case, and 76 in Wislicenus's. The height of the Faulhorn above the level of the Lake of Brienz is, according to trigonometric measurements, exactly 1956 metres. Therefore Fick performed 129,096 and Wislicenus 148,656 metrekilograms of muscular work."

But, in addition to this measurable external work, there is another item of force "which can be expressed in units of work ; and though its value cannot be quite accurately calculated, yet a tolerable approximation can be made. It consists of the force consumed in respiration and the heart's action. The work performed by the heart has been estimated, in a healthy full-grown man, at about 0·64 metrekilogram‡ for each systole. During the ascent, Fick's pulse was about 120 per minute. That gives for the 5·5 hours of the ascent an amount of work which may be estimated at 25,344 metrekilograms, entirely employed in the maintenance of the circulation. No attempt has yet been made to estimate the labour of respiration. One of us has shown, however, in the second edition of his 'Medical Physics' (p. 206), that Donders' well-known investigations concerning the conditions of pressure in the cavity of the thorax give sufficient data for such an estimate. He has there shown that the amount of work performed in an inspiration of 600 cubic centims. may be rated at about 0·63 metrekilogram. Fick breathed during the ascent at an average rate of about 25 respirations per minute, which gives, according to this estimation, an amount of respiratory work for the whole ascent of 5197 metrekilograms. If we add this, and the number representing the work of the heart, to the external work performed by Fick, we obtain a total of 159,637 metrekilograms. If we suppose that Wislicenus's respiratory and circulatory work bore the same proportion to Fick's as his bodily weight did to Fick's—*i.e.*, 7 : 6—we obtain for Wislicenus's amount of work, as far as it is possible to calculate it, a total of 184,287 metrekilograms.

"Besides these estimated (and certainly not over-estimated) items, there are several others which cannot be even approximately calculated, but the sum of which, if it could be obtained, would probably exceed even our present large total. We will try to give at least some sort of an account of them. It must first be remembered that in the steepest mountain path there are occasional level portions or even descents. In traversing such places the muscles of the leg are exerted as they are in ascending, but the whole work performed is transformed back into heat. The same force-producing process, however, must be going on in the muscles as if work were being performed which did not undergo this transformation. In order to make this point yet clearer, we may take into consideration that the whole work of the ascent only existed temporarily as work. On the following day the result was reversed ; our bodies approached the centre of the earth by as much as they had receded from it the day before, and, in consequence, on the second day an amount of heat was liberated equal to the amount of work previously performed. The two parts of the action, which in this case were performed on two separate days, take place in walking on level ground in the space of a footstep.

"Let us observe, besides, that in an ascent it is not only those muscles of the leg specially devoted to climbing

* The speaker showed the combustibility of urea by burning it upon asbestos in a jar of oxygen gas.

† *Phil. Mag.*, vol. xxxi., p. 496, 1866.

‡ 0·43 is here assigned as the work of the left, and 0·21 as that of the right ventricle.

which are exerted; the arms, head, and trunk are continually in motion. For all these movements force-generating processes are necessary, the result of which cannot, however, figure in our total of work, but must appear entirely in the form of heat, since all the mechanical effects of these movements are immediately undone again. If we raise an arm, we immediately let it drop again, &c.

"There was, besides, a large portion of our muscular system employed during the ascent, which was performing no external work (not even temporary work, or mechanical effects immediately reversed), but which cannot be employed without the same force-generating processes which render external work possible. As long as we hold the body in an upright position, individual groups of muscles (as, for instance, the muscles of the back, neck, &c) must be maintained in a state of continual tetanus in order to prevent the body from collapsing. We may conceive of a tetanised muscle as holding up a weight which would immediately fall if the supply of actual energy were to cease. It is active, but it performs no work, and therefore all the force produced is liberated in the form of heat."

Thus the total amount of measured and estimable work performed in 5·5 hours in the experiments before us was 159,637 metrekilograms for Fick, and 184,287 metrekilograms for Wislicenus. This is our second datum.

The third—viz., the amount of muscle oxidised in the body during the performance of this work—has been carefully determined by the same experimenters, as well as the rate of muscle consumption before and after the aacent. For the details of these determinations the speaker referred his hearers to the *Philosophical Magazine* for 1866, vol. xxxi., page 488; but the following is a condensed summary of the results:—

Ascent of the Faulhorn.

	Fick. Gram.	Wislicenus. Gram.
Amount of Nitrogen secreted in Urine per hour before ascent	·63	·61
Weight of dry Muscle corresponding to Nitrogen	4·19	4·05
Amount of Nitrogen secreted per hour during ascent	·41	·39
Weight of dry Muscle corresponding to Nitrogen	2·70	2·56
Amount of Nitrogen secreted per hour during six hours after the ascent	·40	·40
Weight of dry Muscle corresponding to Nitrogen	2·63	2·63
Amount of Nitrogen secreted per hour during the following night	·45	·51
Weight of dry Muscle corresponding to Nitrogen	3·06	3·39
Total amount of Nitrogen secreted during aacent	3·31	3·13
Ditto during six houra after ascent	2·43	2·42
	5·74	5·55
Weight of dry Muscle corresponding to Nitrogen secreted during ascent	20·98	20·89
Ditto during six houra after ascent	16·19	16·11
	37·17	37·00

The results of these determinations add a new link to the chain of experimental evidence, that muscular exertion does not necessarily increase the excretion of nitrogen through the urine. From mid-day before the ascent (August 29, 1865) to the following evening at seven o'clock (August 30) both gentlemen abstained from all nitrogenous food. During these thirty-one hours they had nothing in the way of solid food except starch, fat, and sugar. The two former were taken in the form of cakes. Starch was made up with water into a thin paste, which was then made into small cakes and fried with plenty of fat. The sugar was taken dissolved in tea. In addition to this there was the sugar contained in the beer and wine, which were taken in quantities usual in mountain excursions. It was doubtlesa owing to this absence from food containing nitrogen that the amount of this element secreted through the urine declined tolerably regularly from the 29th of August till the evening of the 30th. Even in the night of the 30th to the 31st, in spite of the plentiful meal of albuminous food on the evening of the 30th, the secretion of nitrogen was less than on the preceding night. The reason of this is probably to be sought for in the circumstance that during the period of abstinence the secretion of nitrogen was carried on at the expense of tissues, and now these tissues required reparation.

It is perhaps scarcely worthy of record that during the ascent neither of the experimenters perspired perceptibly, since it haa been proved by Ranke that no appreciable amount of nitrogen leaves the system in the matter of perspiration; and as Thiry has also shown that no nitrogen is got rid of by respiration, it follows that in addition to the nitrogen contained in the urine, the only other mode of exit for this element is through the fæces. Now, the proportion secreted through the fæces has been estimated by Ranke at about one-twelfth of that in the urine; but inasmuch as all experiments on the subject tend to show that this alvine nitrogen is, as voided, a constituent of unoxidised compounds—that is, of compounds that have not yielded up their force—it has no claim upon our attention.

(To be continued.)

CHEMICAL SOCIETY OF PARIS.

July 20, 1866.

M. Berthelot *in the chair.*

Mr. Charles Murray, Professor of Pharmacy at the Faculty of Medicine at Buenos Ayres, and Member of the Society, presented a "*Traité de Pharmacie et de Pharmacogn sie*," which he had just published in Spanish.

M. Roussille described the modifications which he has introduced into M. Guillermond's method for the estimation of morphia in opium. (This paper will appear in full in an early number of the Chemical News.)

M. Maumené presented to the Society his second volume on the theory of the exercise of affinity.

M. F. Leblanc, the secretary, gave a verbal analysis of a new printed memoir forwarded to the Society by M. Marignac, entitled "*Researches on the Combinations of Tantalum.*" M. Leblanc stated that the new determinations of vapour density, hitherto unpublished, made by MM. Henri Ste.-Claire Deville and Troost, on chloride of tantalum, perfectly pure and free from niobium, agreed completely with the new formulæ given by M. Marignac for tantalic acid, TaO_5, and chloride of tantalum, $TaCl_5$.

M. Berthelot, referring to the communication previously presented to the Society by M. Ladenburg, offered some remarks on the constitution of *anethol*. All the reactions of this body appeared to him easy to explain by regarding it as a derivative, by dehydration, of an ethylic ether of anisic alcohol:

$$C_4H_4(C_{16}H_{10}O_4)-H_2O_2,$$

a constitution capable of synthetical verification.

M. Friedel communicated several crystallographic determinations made by him: 1. On *chloroplatinate of isoamylamine*, a compound which is not isomorphous with chloroplatinate of amylamine. 2. On *thymotic acid*, obtained by M. A. Naquet. 3. On a *citrate of magnesia*, prepared by M. Perrel, the crystals of which present the form of double oblique rhomboidal prisms.

The Society then adjourned, for the vacation, until November 2.

ACADEMY OF SCIENCES.

September 10.

One or two matters of interest to chemists were brought forward at this sitting. M. Pasteur gave a paper "*On the Silkworm Disease*," in which he spoke of the different results obtained when testing the eggs for acidity or alkalinity. In the discussion M. Chevreul said that he had long known the difficulty which was presented when using blue litmus paper as a test for acidity, but which did not occur when using red paper to test for alkalies. The most delicate blue paper owes its colour to the red principle of litmus united with subcarbonate of potash; and when a body reddens this, it only signifies that the substance has more affinity for potash than the red colouring matter of litmus has. But in the preparation of ordinary blue litmus paper, instead of using paper free from mineral matter, the makers use paper containing subcarbonate of lime, sesquioxide of iron, &c. Now subcarbonate of lime also colours litmus blue, and this compound gives up its base to acids with much greater difficulty than the blue potash compound does. Therefore, in order to prepare the most delicate blue litmus paper, the latter should be first soaked in hydrochloric acid, and then well washed, before applying the litmus. Ordinary red litmus paper is much more sensitive to alkaline reaction than blue paper is to acid. M. Chevreul said that the most delicate means to detect acidity was to put a freshly cut piece of Campeachy wood into distilled water. If free from alkali the colour will be yellow, but if there is a trace of alkali present the tint is purple; then add a minute quantity of acetic acid on the point of a quill, when the colour will turn yellow. This liquid becomes purple with a trace of alkali, and acids change the purple to yellow. M. Béchamp gave a paper "*On the Action of Chalk in Butyric and Lactic Fermentations, and on the actually Living Organisms which it contains.*" We will give this paper, which is no less interesting than important, in full in an early number. This was followed by a paper by M. Senistal, "*On Researches in Geometric Optics*," and a memoir by M. H. Violette "*On Resins*," an abstract of which we shall shortly publish. M. Joly finished the sitting with another paper on the interminable subject of "*Silkworm Disease.*"

NOTICES OF BOOKS.

Bibliothèque Universelle et Revue Suisse. Archives des Sciences Physiques et Naturelles. Nos. 97 to 101, January to May, 1866.

We have received the numbers of this journal for the first half of the present year. In future we hope to place before our readers a monthly summary of the contents of each number as far as they relate to chemistry or physics.

No. 97 commences with an important memoir by M. C. Marignac, entitled "*Researches on the Compounds of Niobium.*" The first chapter is devoted to a discussion of the probability of the existence of ilmenium, and the author brings forward a considerable amount of analytical research to prove its non-existence. He is satisfied that the niobic acid extracted from columbite is not a mixture, that its density is about 4·5, and that the two products obtained by M. Hermann, having densities of 5 and 3·8, are mixtures of this acid with bodies of a greater and less density, chiefly tantalic and titanic acids. This conclusion is perfectly in accordance with that arrived at by M. Blomstrand. The second chapter is on the separation of niobic and tantalic acid. Neither Rose's nor Hermann's methods are at all satisfactory, and M. Marignac has devised one which is based on the difference of solubility between fluotantalate and fluoxyniobate of potash. This does not yield perfectly accurate results, but they are a near approximation, and it has the advantage that the compounds so separated have such decided characters, that their nature, and to a certain point their purity, cannot be doubted. The following is the analytical plan adopted:—Having obtained a mixture of niobic and tantalic acids, they must first be re-fused with bisulphate of potash (if they have been ignited), and then boiled several times in water to remove as much as possible of the sulphuric acid; then redissolve the residue in hydrofluoric acid. Add to the boiling solution, hydrofluate of fluoride of potassium, at first in quantity not more than one-fourth of the weight of the metallic acids under treatment. If the solution does not give crystals on cooling, concentrate by ebullition until it occupies no greater bulk than about 7 cubic centimetres for each gramme of metallic acid, and on cooling, fluotantalate of potash will be obtained if the mixture originally contained tantalic acid. Collect the precipitate on a tared filter, wash till the filtrate no longer precipitates infusion of galls of an orange colour, and dry at 100° C. Proceed in the same manner with the filtrates by adding more fluoride of potassium. The moment will be easily seen when the acicular crystals of fluotantalate are mixed with the lamellar crystals of fluoxyniobate, and these may then be redissolved by the addition of a little water before collecting the fluotantalate on a filter. The whole of the niobic acid remaining may now be converted into the lamellar crystals of fluoxyniobate, and collected in that state, or the solution may be decomposed by evaporation with sulphuric acid and treatment with water to separate the niobic acid. The author finds that all columbites contain, along with niobic acid, tantalic, titanic, and atannic acids, but he brings forward arguments to show that this association is purely accidental.

The third chapter contains analyses of several niobiferous minerals. The composition of columbites and tantalites is represented by the formula

$$\left.\begin{matrix}FeO\\MnO\end{matrix}\right\}\left\{\begin{matrix}Nb_2O_5\\Ta_2O_5\end{matrix}\right.,$$

and the extreme limits of their composition will be—

Tantalite.		Niobite.	
Ta_2O_3 .	85·5	Nb_2O_5 .	78·8
FeO . .	14·5	FeO . .	21·2
	100·0		100·0

Tantalic, titanic, and niobic acids have been found in wolfram. Euxenite appears to contain about 49 per cent. of niobic acid and 44 per cent. of titanic acid—the rest being water, and the loss incidental to this method of analysis.

No. 98 contains a paper by M. Marc Delafontaine, entitled "*Contributions to the History of the Metals of Cerite and Gadolinite.*" He criticises the results obtained by MM. Bahr and Bunsen and M. Mosander, and comes to the conclusion that yttria and erbia certainly do exist, possessing all the properties which Mosander has ascribed to them; and that the erbia of MM. Bahr and Bunsen is a new earth, which should have its name altered.

Yttria is the earth about which there is least difference of opinion. It is white even after strong ignition. The sulphate and yttriopotassic sulphate, the nitrate and oxalate are fully described. The atomic weight is between 460 and 470 (O = 100). Erbia, according to M. Delafontaine, is of a yellow colour. The sulphate, the erbiopotassic sulphate, carbonate, and oxalate are described. When the double sulphate of erbium and potassium is washed with a cold saturated solution of sulphate of potash, it is noticed that the salt becomes less and less rose-coloured, and *at last its solution will not give an absorption spectrum.* To prepare an earth rich in erbia, the author recommends to prepare a concentrated solution of the mixed yttria, erbia, terbia, ceria, &c., and add an excess of a boiling saturated solution of sulphate of potash, and some crystals of the same. The whole is then allowed to cool; a crystalline deposit is formed, which is separated from the mother liquor, and digested again in fresh quantities of cold

sulphate of potash. This latter dissolves a double salt, consisting chiefly of sulphate of erbia and potash; ceria and the other earths remain in the insoluble portion. Respecting the hypothetical terbia, M. Delafontaine brings forward reasons which tend to show that the earth which gives an absorption spectrum (the erbia of MM. Bahr and Bunsen) is a distinct body, and probably is terbia.

We have therefore in gadolinite (besides the cerium metals) *at least* three distinct earths—

1. Yellow erbia.
2. Rose-coloured terbia.
3. White yttria;

and there is some probability of there being a fourth.

The author has redetermined the atomic weight of yttria, and makes it 74·5.

No. 99 contains "*Researches on Earth Currents of Electricity*," by M. L. Dufour; "*On the various Modes of Coloration of the Feathers of Birds*," by M. Victor Fatio; and an article by M. H. Ste.-Claire Deville "*On Affinity and Heat.*"

In No. 100, M. F. Cranceri describes "*A New Anemometer*," and M. W. Hankel gives a "*Determination of Electromotive Forces.*"

No. 101 contains an article by M. P. J. Ruprecht "*On the Scientific Importance of Tschornozome, or Black Earth*," and one by M. L. Dufour "*On the Secondary Polarisation of Metallic Conductors buried in the Earth.*"

Chemisches Central Blatt. Nos. 35, 36, and 37.

These numbers are entirely filled with articles translated from other periodicals, most of them having already appeared in the Chemical News. Thus the first article in No. 35 is one by Dr. Martius "*On Amido-dinophthylimid and Diazo-amidonaphtol*," which we gave in April. The next article is one by Dr. Fleck "*On the Separation of Cobalt and Nickel*," an abstract of which appeared in the Chemical News for June 22. Then follows a paper by Dr. Gräger "*On the Estimation of Potash in the Presence of Soda*," noticed in our number for August 3. The last paper is by Dr. G. Lunge "*On Swan's Carbon Printing Process in Photography*," copied from a Breslau journal for 1865; it is a *résumé* of the process which is now so well known to all photographers. The rest of the number consists of short notices from the *Comptes Rendus* and other papers.

In No. 36 the first article is one by W. Müller "*On the Reactions between Oxysalts and Sulphide of Carbon, Sulphuretted Hydrogen and Hydrochloric Acid at a High Temperature.*" By putting chromate of potash in a red-hot tube and passing over it the vapour of bisulphide of carbon, combination takes place, and on extracting with water sesquisulphide of chromium Cr_2S_3 is left behind, insolnble in water, only slightly attacked by hydrochloric, but readily and completely dissolved by strong nitric acid and aqua regia. The reaction is expressed by

$$2(KO,CrO_3) + 5CS_2 = 2KS_3 + Cr_2S_3 + 4CO + CO_2 + 2SO_2.$$

With antimoniate of potash the reaction is

$$2(KO,SbO_5) + 5CS_2 = 2(KSSbS_3) + 3CO_2 + 2CO_2 + 2SO_2.$$

With manganate of potash the reaction is

$$KO,MnO_3 + 2CS_2 = KS_3 + MnS + 2CO_2.$$

The author has examined the reaction between sulphide of carbon and manganate of baryta, paraphosphate of soda, and phosphate of potash; between sulphuretted hydrogen and chromate of potash, and oxalate of potash; and between hydrochloric acid and antimoniate of potash and chromate of potash. The next article is one on Lenk's "*Gun-cotton.*" This is followed by one by R. Schneider "*On a new Compound of Sulphide of Mercury with Sulphide of Potassium*," and by Dr. Wurtz's paper on the "*Synthesis of Chloride of Thionyle*," which appeared in our number for March 9.

No. 37 is also filled with papers which have already been noticed in our pages.

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W. C.

2125. G. E. Moore, Birmingham, "Improvements in apparatus for filtering and purifying water and other fluids."—August 18, 1866.

2145. W. E. Newton, Chancery Lane, "Improvements in the mode of, and apparatus for, the distillation, rectification, and disinfection of mineral and vegetable oils, applicable also to the purification and rectification of fatty and other products of such oils." A communication from J. B. Lahore, Rue St. Sébastien, Paris.—August 21, 1866.

2148. W. Wield, Manchester, "Improvements in treating carrageen or Iriah moss, sea weed, and like plants, to reduce them into a state of powder or meal, and in arrangements and apparatus to be used for the purpose."

2153. H. Caro, Manchester, "Improvements in the preparation of colouring matters."—August 22, 1866.

2355. W. Weldon, West Hill, Highgate, Middlesex, "Improvements in the production of sulphide of sodium, and in the treatment thereof for the manufacture of soda."—Petition recorded May 11, 1866.

2062. W. Mosley, jun., Salford, Lancashire, "Improvements in furnaces."—August 11, 1866.

2201. W. Pierce, Over Darwen, Lancashire, "Certain improvements in the method of purifying gas, whereby its illuminating properties are improved, and in the apparatus connected therewith."

2204. H. A. Dufrené, Rue de la Fidélité, Paris, "Improvements in the manufacture of beer and other alcoholic liquids, and in the apparatus employed therefor."—A communication from C. Tellier, Rue Boulainvilliers, Passy, Paris.—August 27, 1866.

2215. W. E. Newton, Chancery Lane, "An improved mode of preventing oxidation of lead balls in fixed ammunition."—A communication from B. H. Jenks, Bridesburgh, Penn, U.S.A.

2218. R. Irvine, Magdalen Bridge, near Musselburgh, Midlothian, N.B., "Improvements in treating and purifying water."—August 28, 1866.

2225. J. C. Dickinson, Boston, Lincolnshire, "An improved dipping mixture for sheep and lambs."

2230. J. Davis, Sussex Road, Southsea, Hants, "An improved method of treating limestone and applying the products for purifying and rendering water palatable, and for imparting a briskness to other beverages, as also for utilising the substances to the various purposes of the builder."—August 29, 1866.

2241. H. E. Newton, Chancery Lane, "An improved process for treating and preserving beer and other fermented liquors." A communication from E. Velten, Boulevart Beaumarchais, Paris.—August 30, 1866.

Notices to Proceed.

1257. S. Bourne, Harrow, Middlesex, "Improvements in treating india-rubber and india-rubber compounds, and also india-rubber fabrics."—Petition recorded May 3, 1866.

1263. A. T. Becks, Birmingham, "Improvements in the manufacture or treatment of iron."

1274. J. G. Hope, Edinburgh, N.B., "An improved composition for destroying vermin on sheep and other animals, and for preserving them therefrom."

1278. W. Young, Straiton, Midlothian, and P. Brash, Leith, Midlothian, "Improvements in the distillation of coal, shale, and other bituminous substances, to obtain oily matters therefrom, also in the redistillation of products thereby obtained."—May 4, 1866.

1291. H. K. York, Cardiff, "Improvements in the manufacture of iron and steel."—May 5, 1866.

1320. J. L. Norton, Ludgate Hill, London, and A. Giles, Manchester, "Improvements in apparatus to be employed

in evaporating volatile and combustible liquids to obtain light or heat therefrom."—May 8, 1866.

1341. J. H. A. Bleckmann, Solingen, Prussia, "An improved explosive compound."—A communication from W. Fehleisen and E. Fehleisen, Cilli, Styria, Austria.—May 10, 1866.

1395. W. Clark, Chancery Lane, "Improvements in furnaces and other fireplaces."—A communication from F. M. Piret and E. Michel, Boulevart St. Martin, Paris.—May 16, 1866.

1471. J. D. Whelpley and J. J. Storer, Boston, Suffolk, Massachusetts, U.S.A., "Improvements in the use and application of fuel, and of chemical reagents to eliminate its impurittes or those of the substances it is to heat."—May 26, 1866.

1493. J. D. Whelpley and J. J. Storer, Boston, Suffolk, Massachusetts, U.S.A., "An improved process and apparatus for obtaining metals and saleable products from ores and minerals, adapted particularly to the reduction of sulphurets."—May 29, 1866.

1888. M. A. F. Mennons, Rue Laffitte, Paris, "Improvements in the mode of, and apparatus for, generating gas for lighting, heating, and other purposes."—A communication from J. Z. Paszkowsk and O. Sabinski, Brussels, Belgium.—July 20, 1866.

CORRESPONDENCE.

On Certain Reasons for Doubling or otherwise Multiplying Chemical Formulæ.

To the Editor of the Chemical News.

Sir,—In reply to my argument showing that the probabilities were greatly against the formulæ at present employed for water, hydrochloric acid, &c., Dr. Stevenson stated that the presumption was in their favour. I therefore naturally understood him to mean that there was at least some preponderance of probability in favour of the system he had so warmly defended. It now seems, however, that when he stated that the "presumption was in favour of the simpler formulæ," he did not mean to assert that there was "a preponderance of probability in its favour, but such a preoccupation of the ground as implies that it must stand good till some sufficient reason is adduced against it." He supports the present formulæ, therefore, not because he can adduce any proof of their absolute correctness, nor even because he considers the preponderance of probability to be in their favour, for he has already virtually admitted that there are millions of chances to one against them, but simply because they are at present in use—because, so to speak, they preoccupy the ground.

With reference to the present formulæ, I may say that I consider them as convenient modes of expressing the relative number, and not the absolute number, of atoms in a given molecule. Dr. Stevenson, on the other hand, appears to regard them as expressing the absolute number of atoms in a given molecule. Hence the difference between us. We are both agreed about the propriety of leaving the present formulæ untouched for all ordinary uses; but whilst I see no harm in multiplying the formulæ for some special purposes, Dr. Stevenson seems to regard them as containing some truth which must at all hazards be preserved inviolate. I look upon the formulæ just as I regard the atomic weights themselves, as embodying a relative and not an absolute expression. Dr. Stevenson says that exchanging two affinities amounts to the same thing as interchanging one affinity. I would, however, beg leave to remind him that he seems to use the expression exchanging two affinities when he appears to mean interchanging two affinities, and that, too, in the same paper in which he speaks of exchanging two affinities as equivalent to interchanging one affinity.*

With regard to the alleged misquotations, I do not see that I have in any way materially altered the sense of Dr. Stevenson's remarks, and I think that any one who takes the trouble to peruse our correspondence will perceive that I have endeavoured to elicit the true meaning of the Doctor's observations.

I am, &c.

John A. R. Newlands, F.C.S.

Laboratory, 19, Great St. Helens, E.C., Sept. 17.

Reduction of Magnesium, Chromium, &c.

To the Editor of the Chemical News.

Sir,—Your correspondent, "A Novice," asks the reason "why magnesium and aluminium are not reduced from their oxides by carbon like other metals." In seeking for an explanation of this anomaly a few further considerations present themselves which I beg in turn to submit to the notice of your readers.

I am inclined to believe that magnesium, like the other metals of the alkaline earths, barium, strontium, and calcium, is incapable of reduction by carbon, in consequence of the infusible nature of its oxide and the practical impossibility of bringing the two substances into absolute contact. The same difficulty presents itself in attempting the reduction of aluminic oxide by carbon, and we should probably have expected no different result in the case of chromium had not Deville and others already stated the contrary. I quote from Fownes' "Manual of Chemistry," 8th edition, p. 318:—"The metal itself (chromium) is got in a half-fused condition by mixing the oxide with one-fifth of its weight of charcoal powder, enclosing the mixture in a crucible lined with charcoal, and then subjecting it to the very highest heat of a powerful furnace. Deville has prepared metallic chromium by reducing pure sesquioxide of chromium, by means of an insufficient quantity of charcoal in a lime crucible."

The above explanation, if true in the instances of magnesium, aluminium, &c., leaves us still unable to account for the reduction of chromium under similar circumstances. Is lime capable of forming a fusible combination with chromic oxide; or are small quantities of foreign metallic oxides in admixture, particularly those of iron and manganese, likely to aid in the reduction? The chemical properties of the metallic chromium thus obtained are described as being nearly identical with iron, and suggest the possibility of that metal sharing with it the power of combining with carbon, silicium, &c., and of having its fusing point thereby considerably reduced, and such analogy may likewise indicate a similar mode of reduction—viz, by the operation of gaseous carbonic oxide. Zinc oxide, although not itself fusible, gives up its metal by heating with carbon, but in this case the well-known reducing action of carbonic oxide certainly comes into play, and the volatile nature of the products has no doubt an influence in determining the chemical change.

It would be interesting to know whether mixtures of carbon with aluminic and chromic oxides respectively would furnish the corresponding metals in a properly regulated (reducing) atmosphere, and at the excessively high temperature of Deville's gas furnace.

I am, &c.,

F. C. S.

MISCELLANEOUS.

Prospects for the Dundee Meeting of the British Association.—The *Glasgow Herald* contains the following report of proceedings at the meeting of the Brechin Town Council on Wednesday last:—"The clerk

* "By making C_2 in carbonic acid" (probably a misprint for carbonic oxide) "exchange two affinities, we get rid of the apparent exception to the quadrivalence of carbon in that compound, which is what Mr. Newlands wishes to do."—Dr. Stevenson, Chemical News, July 27, 1866.

read a letter from the local secretaries of the British Association at Dundee, requesting the co-operation of the Council in order to make next year's meeting a successful one, and to appoint a committee for endeavouring to insure that object. The Provost: They are looking for a sum of money, that is quite clear. Mr. P. Guthrie: I think the money might be spent in a better way. All that I know is that at the meeting at Nottingham this year they have propagated infidel principles, and that is the only thing I know they have done. The Provost: Yes; I think that on some other points, again, they have given us additional information. Bailie Craig: There is one thing to be said; if men spread infidel opinions, there is sufficient information in the public press to put it down; and I believe that religion will never collapse by any attack of so-called science. Mr. P. Guthrie: I quite agree with you. The question is, are we to encourage it? Bailie Craig: I would not encourage anybody to propagate and disseminate infidel opinions, but I believe that science, properly so called, must always be consistent with religion, and what is in the Bible; and there are sufficient defenders of the faith to refute any charges that may be brought against the truths contained in the Bible. There are so many much abler defenders of the faith than those who attack it that, in my opinion, the truth will come out untarnished. My motto is, '*Magna est veritas et prævalebit.*' The Provost: There is one thing I am very glad to see, that Bishop Forbes has prepared and published a letter encouraging all parties to study in order to be able to meet these infidel opinions at the next meeting, when there will be a fair battle. Mr. P. Guthrie: I quite agree with you; but I don't see that it is necessary for us to encourage such an association. Bailie Craig: We don't encourage anybody to propagate heretical opinions. We rather encourage individuals to defend what we call the doctrines of the faith, which will be done at the subsequent meeting, I have not the slightest doubt. I see a very great deal of discussion has taken place upon Grove's speech, and very able arguments have already been brought forward against it. I don't think we need be at all discouraged. Mr. P. Guthrie: I don't believe but that these people will be driven down very shortly; but if that association is for the purpose of inculcating infidel doctrines, I don't see what necessity we have to encourage it. As I have said already, I believe these men will be thoroughly driven down. Mr. Mill: The association takes all and sundry. It is just as well that their opinions should be ventilated and exposed. Mr. P. Guthrie: If you like to encourage that sort of thing. Mr. Mill: I will encourage the association; but not infidelity. Mr. P. Guthrie: Very well; if you will encourage it just do it, Mr. Mill. Mr. Mill: But you cannot help it. The Provost: It is but a small section of the association. I don't know how many sections there may be. I was just in a small section. Mr. P. Guthrie: It is the section that bears upon the truth of the Bible. The Provost: Grove, being president of the association, should never have led off with that sort of thing. If he had confined the subject to his being the convener of the section, it would not have been so objectionable. But it is rather a question we should not enter into just now. I move that the letter lie on the table till next meeting. This was unanimously agreed to."

The Royal Observatory.—For some time past Mr. John Browning, a gentleman well known in scientific circles, has been erecting, under the supervision of the Astronomer Royal, and Mr. Glaisher, a new set of instruments for registering the speed and pressure of the wind. As the instruments are both near completion, and are, indeed, in operation, a description of them cannot be read without interest. The first, for registering the force of the wind, consists of a circular plate of metal of a diameter equal to two square feet in area, supported by eight tempered steel springs. When the wind impinges on the circular plate the springs are brought consecutively into action, the stronger coming into play before the weaker have received any strain. The plate is kept constantly facing the wind by means of a direction vane. From the plate a fine flexible wire is carried down through a hollow pillar which supports the vane, the whole apparatus being in a room below. The wire governs the motion of a pencil, which is made to traverse a table covered with slate, on which is strained a sheet of paper marked with the hours. This table is moved by clockwork, and the pencil being regulated by the pressure-plate registers on the paper the pressure of the wind during every portion of the twenty-four hours. The instrument, which is capable of registering as light a pressure as even two or three ounces on the square foot, will in strong gales have to withstand a force of 40 lbs. to the square foot.—*Times*, September 13, 1866.

Novel Remedy for Steam-Boiler Incrustations.—The members of the British Association were recently favoured, at Derby, with the following description of a new mode of preventing the formation of calcareous deposits in steam-boilers, told, not as a joke, but seriously:—Within the dome of a stationary boiler are mounted a series of small horse-shoe magnets, carefully insulated by electric non-conductors from the adjacent metallic parts and anterior portion of the boiler, but connected with each other by copper wires, and by the same means placed in communication with the back part of the boiler, so that the magneto-electric current generated by the action of the steam may be conducted from front to rear and induce opposite electrical states or polarity, whereby it is believed that the tendency to crystallisation of the calcareous particles thrown down upon ebullition will be overcome or counteracted by the unfavourable electrical condition in which both the plates and contents of the boiler are maintained, and that no adherent crust will, under such circumstances, be formed. It was further stated that this ingenious process was still under trial, but already the preliminary indications were said to be giving great promise of success, and the magnets only required occasionally retouching.

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E C. *Private* letters for the Editor must be so marked.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

A. B. wishes to know the best market for purchasing paraffin wax.

Vulcan.—An immense fortune could be made by any one who succeeded in doing what you ask.

O. O.—Consult the index of our last volume.

Thomas Davies.—Angelic acid is prepared by saponifying essence of camomile with hydrate of potash.

A Manufacturer asks if any one can supply him with a formula for making green and yellow ink that will dye cotton spots in woollen pieces.

P. H. R.—Liebig has written several works on agricultural chemistry. Lawes and Gilbert's paper is published in the *Transactions* of the Royal Agricultural Society. Messrs. Clowes and Sons will probably give you information.

F. C. Y.—Dr. Percy has found gold in almost every sample of commercial lead and its salts which he has examined. See his paper on the subject in the *Phil. Mag.* for February, 1864.

James.—No process is known for estimating traces of carbolic acid when dissolved in water. If you are certain no other organic matter but carbolic acid is present, you may estimate it by means of a standard solution of permanganate of potash.

Brewer's Man.—Picric acid may be detected in beer by pouring into the liquid an excess of tribasic acetate of lead, and filtering. Pure beer is almost immediately decolorised, whilst if picric acid is present the solution will remain of a citron-yellow colour.

J. H. Myers.—Permanganate of potash is made by adding a solution of 10 parts of caustic potash, in a very small quantity of water, to a finely divided mixture of 8 parts of peroxide of manganese and 7 parts of chlorate of potash. Evaporate to dryness; ignite at a low red heat; reduce to coarse powder; boil in water; filter through asbestos; evaporate; filter again, if necessary, and allow to crystallise.

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THE

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AND

Journal of Physical Science.

Edited by] [*Wm. Crookes, F.R.S.*

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Chronicles of Science.
The Science Teachers' Association.
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STAMPING OUT THE CATTLE PLAGUE.

Notwithstanding the steady decline in the weekly returns of cattle plague cases, testifying to the success of the measures recommended by the Cattle Plague Commission and carried out by the Government, there is great reason to apprehend that the evil is by no means diminished to the extent which a reference to the bare statistics would justify us in assuming. From all that we are able to learn, the disease has lost little, if any, of its virulence. When it appears on a farm, it is as likely to go through the whole stock as when it was at the height in February last; and were the cattle allowed to linger on as in the early days, there is no doubt that the proportion of deaths to recoveries would be equally great. The plague is simply being kept under by main force, and probably part of its rapid decline may be due to the fact that during the last few months the cattle have been almost entirely in the fields instead of being tied up in sheds. The time, however, is rapidly approaching when the supply of green food will fall off, and the greater part of the stock will be concentrated in the farm buildings. Now, whatever may be the amount of safety conferred upon cattle by strict isolation in thoroughly disinfected sheds—and, with the plague in the neighbourhood, it is generally admitted that a well-disinfected shed is the safest place for an animal—it is self-evident that, when the disease does attack one of a herd, it will pass from one to another with far greater rapidity when they are shut up together, than when they are in open fields; and there is danger that, if the disease is not entirely stamped out within the next six or eight weeks, it will begin to spread again; and although the experience and organisation which has now been acquired may probably prevent it from again assuming serious proportions, this immunity can only be purchased with the continuance of the irksome, though most necessary, regulations now in force. We wish to call attention to a plan which is the result of some successful attempts to stamp out the cattle plague from a considerable tract of country in the neighbourhood of Stafford, where it was raging with great virulence when our operations were commenced.

Until the publication of the Third Report of the Cattle Plague Commission, it was universally considered that an animal, after being infected, passed through a period of incubation, which varied from three to five days; and it was only towards the end of this period that the disease could be detected. At this stage the alteration of the mucous membranes had commenced, and the exhalations and discharges were loaded with virus, and were highly infectious. It followed, therefore, that the disease could not be detected in an animal until it was so far advanced as to be highly dangerous to others; and even were the most rigorous measures of isolation and killing adopted, it would scarcely prevent the plague going right through a herd when once introduced; for the disease could not be observed in the first animal, until it had infected a second, and the second would not appear ill until it had communicated the plague to a third, and so on. The disease would commence with a start of at least forty-eight hours, and would keep this much ahead until the last animal had succumbed. The precautionary measures might closely follow, but would never outstrip its progress.

Recent researches, and especially those of Dr. Sanderson, have now placed us in possession of a method of getting ahead of the disease in its progress through a herd. The judicious use of the thermometer* will now point out when the animal is *about to take* the disease, whilst it is still in the exercise of its healthy functions. We are by this means placed in possession of the ground almost before the enemy approaches. We can seize upon an animal, and separate it from the rest when it is in the first initial stage of the disease, and at least twelve hours before it becomes capable of communicating infection to another. To use a not uncommon simile, let us compare a herd of cattle to a row of cards on end. If the first is overthrown, it strikes against the second, and causes it to fall; the second overthrows the third; and so on to the end of the pack. The measures hitherto adopted in an infected district are similar to those of a person following the falling cards, and quickly removing one *after* it has struck down the one in front of it. But, by the employment of the thermometer, we are enabled to adopt measures which may be compared to the arresting of a card at the very commencement of its fall, and *before* it could touch the one before it.

Armed, therefore, with the thermometer, possessed of the responsibility instantly to kill apparently healthy animals on the strength of its indications, and supplementing this with vigorous disinfecting measures, the stamping out of the cattle plague on any infected farm, district, or county, is, in theory, reduced to a mathematical certainty.

The average normal temperature of a healthy animal is about 102°F., but this may vary in different herds, sometimes rising as high as 103·5° without danger. A certain temperature, say 103°, should be fixed upon as an arbitrary limit between health and disease, and the stock in an infected district should be carefully examined with the thermometer once or twice a day at milking time.

A thoroughly well disinfected shed should be set apart, as far as possible removed from the healthy stock; and when a temperature is recorded of above 103°, the animal should be placed in this shed in quarantine. If on subsequent examination the temperature of an animal in quarantine were found to sink to below the fixed limit, it might be considered to show that it was not in an incipient stage of the disease, and it might be replaced amongst the general stock; but if its temperature were found to be rising, it should be slaughtered without a moment's delay as soon as the thermometer registered—say 103·5° or 104°. At this point, the animal, if on an infected farm, is pretty certain to be in an early stage of the disease; but as no outward signs of it whatever are apparent, as the most skilful expert in the country would probably pronounce it healthy upon ordinary inspection, there is no reason to fear that it has arrived at the infectious stage of the disease.

It may, however, be urged that a rise in temperature may take place without its being due to cattle plague. This is true; but in an infected herd it is very much more probable that the increased temperature is due to the particular disease to which the animals are exposed than to any other ;† and when there are nine chances in favour of the rise in temperature being caused by incipient cattle plague, and only one chance in favour of its being due to some other cause, it is certainly worth while to secure the safety of the rest of the herd at the risk of occasionally slaughtering an animal which, after all, might not be sickening for the disease.

The plan of disinfection, which should in all cases go hand in hand with the above system of detection and slaughter, is similar to the one already described in the

* See Dr. Sanderson's Report, page 17.

† Dr. Sanderson's Report, page 16.

Third Report of the Cattle Plague Commission, with such alterations as further experience has shown to be necessary. They have now been too fully tested in every infected county in the kingdom, to leave any doubt as to their efficacy.

So long as the deaths from the plague were several hundreds per week, it was hopeless to attempt its stamping out by any such stringent measures as are here suggested; but now that the centres of infection are few in number, it becomes a question whether the time has not arrived for such a system of intelligent but uncompromising slaughter to be carried into successful operation. If simultaneously adopted all over the country by a sufficient staff of skilled officers, there is every human probability that the Cattle Plague would be extirpated in less than a month's time.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

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PART III.

CONNEXION BETWEEN ORGANIC AND INORGANIC CHEMISTRY.

SECTION IV.—*Inorganic and Organic Chlorides, Bromides, &c.*

(*Continued from page* 135.)

IN all the chlorhydrines which still contain one or more atoms of typical hydrogen, this hydrogen may be replaced by radicals of acids. M. Berthelot* has described, under the name of benzochlorhydrine, a glyceric compound which may be looked upon as chlorhydrine in which 1 atom of typical hydrogen has been replaced by the benzoyl radical.

$$\left.\begin{matrix}(C_3H_5)''' \\ H_2 \\ Cl\end{matrix}\right\}O_2, \qquad \left.\begin{matrix}(C_3H_5)''' \\ H.(C_7H_5O) \\ Cl\end{matrix}\right\}O_2.$$

Monochlorhydrine. Benzochlorhydrine.

Mr. Maxwell Simpson† has likewise prepared an analogous ethylenic compound—viz., acetochlorhydrine of glycol, or acetochlorhydric glycol; he obtained it by submitting glycol to the simultaneous action of hydrochloric and acetic acids. This body represents chlorhydric glycol, whose typical hydrogen has been replaced by the acetyle radical.

$$\left.\begin{matrix}(C_2H_4)'' \\ H \\ Cl\end{matrix}\right\}O, \qquad \left.\begin{matrix}(C_2H_4)'' \\ C_2H_3O \\ Cl\end{matrix}\right\}O, \quad \text{or} \quad \left.\begin{matrix}(C_2H_4)'' \\ C_2H_3O\end{matrix}\right\}O\ Cl$$

Chlorhydric glycol. Acetochlorhydric glycol. Ethylenic acetochlorhydrine.

We know a certain number of inorganic compounds that possess an analogous constitution.

When we evaporate an aqueous solution of equivalent quantities of acetate of lime and of chloride of calcium, we obtain large crystals permanent in the air, which contain, according to the analysis of M. Fritzsche—

$$CaCl + C_4H_3CaO_4 + 10HO.$$

This substance is a calcic acetochlorhydrine,

$$\left.\begin{matrix}Ca'' \\ C_2H_3O \\ Cl\end{matrix}\right\}O + 5H_2O$$

Calcic acetochlorhydrine.

M. Carius‡ has lately described some plumbic compounds anologous to the preceding, and has perfectly ascertained and defined their constitution. These compounds are formed by the direct addition of chloride, bromide, or iodide of lead to a solution of acetate of lead made acid with acetic acid. Their composition may be expressed by the following formulæ:—

$$\left.\begin{matrix}Pb'' \\ C_2H_3O \\ Cl\end{matrix}\right\}O, \qquad \left.\begin{matrix}Pb'' \\ C_2H_3O \\ Br\end{matrix}\right\}O, \qquad \left.\begin{matrix}Pb'' \\ C_2H_3O \\ I\end{matrix}\right\}O,$$

Plumbic acetochlorhydrine. Plumbic acetobromhydrine. Plumbic aceto-iodhydrine.

Let us here remark that the existence of these calcic and plumbic compounds furnishes a good argument in favour of the diatomicity of calcium and of lead, which may be compared in this respect to ethylene.

By dissolving the basic tetrachloride of chromium in ammonia (page 6), M. Hugo Schiff§ obtained a salt which he calls acetotetrachloride of chromium, and whose composition he represents by the formula—

$$\left.\begin{matrix}[Cr_2]^{vi} \\ 2C_2H_3O \\ Cl_4\end{matrix}\right\}O_2 + 4aq.$$

He also describes a sulphodichloride—

$$\left.\begin{matrix}(Cr)^{vi} \\ 2(SO_2)'' \\ Cl_2\end{matrix}\right\}O_4 + 2aq.$$

and a nitrotetrachloride—

$$\left.\begin{matrix}[Cr_2]^{vi} \\ 2NO_2 \\ Cl_4\end{matrix}\right\}O_2$$

which possesses an analogous constitution.

Further, he justly proposes to consider the ferric acetochloride described by M. Scheurer-Kestner‖ as an acetochlorhydrine—

$$\left.\begin{matrix}[Fe_2]^{vi} \\ 3C_2H_3O \\ H \\ Cl_2\end{matrix}\right\}O_4 + 3aq.$$

There are a certain number of minerals which possess a constitution analogous to that of the acetochlorhydrines just mentioned. Thus there are wagnerite and apatite, well-defined kinds of minerals. Their composition is usually represented by the formulæ—

$$PO_5, 3MgO + MgFl; \text{ and } 3(PO_5, 3CaO) + CaFl;$$

and they are looked upon as double compounds of phosphates and of fluorides or of chlorides. If we adopt for oxygen, magnesium, and calcium, atomic weights double their equivalents, the preceding formulæ become, in the typical notation—

$$\left.\begin{matrix}(PO)''' \\ 2Mg'' \\ Fl\end{matrix}\right\}O_3 \qquad \left.\begin{matrix}3(PO)''' \\ 5Ca'' \\ Fl\end{matrix}\right\}O_9$$

Magnesian phosphofluorhydrine (wagnerite). Calcic triphosphofluorhydrine (apatite).

Here there is an important remark to be made. Ordinary phosphoric acid

$$\left.\begin{matrix}(PO)''' \\ H_3\end{matrix}\right\}O_3$$

requires, to saturate it, more than 1 molecule of magnesia—

$$Mg''O. \quad (Mg = 24),$$

for

$$Mg'' \text{ only equals } H_2;$$

but 2 molecules of magnesia, which contain 2 atoms of magnesium, are too much for saturation—in fact,

$$2Mg'' \text{ equals } H_4$$

* *Annales de Chimie et de Physique*, 3rd series, vol. xli., p. 301.

† *Proceedings of the Royal Society*, vol. ix., p. 725.

‡ *Annales de Chimie et de Physique*, 3rd series, vol. xviii., p. 207.

§ *Annales de Chimie et de Physique*, 3rd series, vol. lxvi., p. 147.

‖ *Ibid.*, 3rd series, vol. lxiii., p. 422.

and phosphoric acid only contains H_3. Now, wagnerite contains exactly 2 atoms of magnesium: it would then be supersaturated if the fourth unit of combination of the group

$$2Mg''$$

was not saturated by fluorine. The same reasoning applies to apatite and to the calcium which it contains. We see that, when looked at from the dualistic point of view, the fluorine or chlorine plays an important and necessary part in these compounds, whose composition appears at first so strange. I may add that the presence of such a monatomic element in these compounds furnishes an argument in favour of the diatomicity of magnesium and calcium. If magnesium were monatomic, the fluorine would be useless, for

$$3Mg(Mg=12)$$

could replace 3H in ordinary phosphoric acid $PH_3\Theta_4$. But this metal, together with calcium, being diatomic, and therefore of even atomicity, the presence of a monatomic element is necessary to complete the uneven atomicity of the phosphoryl $(P\Theta)'''$.¶

We may extend this point of view to other compounds. There is a chlorophosphate of lead whose composition is exactly analogous to that of apatite. It is pyromorphite—

$$\left.\begin{matrix}3(P\Theta)''' \\ 5Pb''\end{matrix}\right\}\Theta_9$$
$$Cl$$

Pyromorphite.

a mineral in which calcium and fluorine may replace a certain quantity of lead and chlorine. Mimetese offers an analogous constitution, except that a certain quantity of phosphoric acid is replaced by arsenic acid.

Cerasine, or horn lead, forms a chlorocarbonate of the form—

$$\left.\begin{matrix}2Pb'' \\ C\Theta \\ Cl_2\end{matrix}\right\}\Theta_2$$ derived from the hypothetical hydrate $$\left.\begin{matrix}2Pb'' \\ H_4\end{matrix}\right\}\Theta_4$$

I should likewise point out that this formula may be written—

$$\left.\begin{matrix}2Pb'' \\ C\Theta\end{matrix}\right\}\begin{matrix}\Theta_2 \\ Cl_2.\end{matrix}$$

And the same remark applies to the formulæ of all the organic and inorganic chlorhydrines. The notation I have hitherto preferred to employ** shows more clearly than the preceding formula the relations of these chlorhydrines to the corresponding hydrates.

Gerhardt has analysed a mercurous nitrophosphate which contains one molecule of mercurous phosphate united to one molecule of mercurous nitrate. This compound, represented in equivalents by the formula—

$$NO_5,Hg_2O+PO_5,3Hg_2O+2HO,$$

may be considered as a kind of wagnerite in which the magnesium is replaced by mercurosum ($Hg_2=400$) and the fluorine by nitrous gas—

$$\left.\begin{matrix}(P\Theta)''' \\ 2[Hg_2]''\end{matrix}\right\}\begin{matrix}\Theta_3 \\ (N\Theta_2)'\end{matrix}+H_2\Theta.$$

(To be continued.)

¶ My friend, Dr. Odling, has called my attention to a salt described by M. Briegleb (*Annalen der Chemie und Pharmacie*, vol. xcviii., p. 95), and represented by the formula $3NaO,PO_5+NaFl+24HO$. Without attempting to deny that the existence of this salt weakens the argument drawn from the constitution of wagnerite in favour of the diatomicity of magnesium, I would, however, point out:—

1. That this salt is very unstable, for boiling water decomposes it into a phosphate and a fluoride. We know, on the other hand, that wagnerite and apatite possess great stability, and that, when they contain chlorine, boiling water never extracts from them chloride of magnesium or calcium.

2. That it is impossible to obtain the corresponding fluophosphate of potassium.

3. That the salt in question contains water of crystallisation, and that, even in this respect, it is not comparable to wagnerite.

We owe to M. Cannizzaro another argument in favour of the diatomicity of calcium and barium. This is it—There is neither a quadroxalate of calcium nor a quadroxalate of barium, whilst there is a quadroxalate of potassium. In fact, an atom of hydrogen may be replaced in two molecules of oxalic acid by an atom of potassium, but not by a diatomic atom of calcium—

$$(Ca''=40).$$

As the latter displaces two atoms of hydrogen, the product of the substitution can be only a binoxalate or a neutral oxalate.

** M. Weltzien proposed this notation the same time that I did.

On the Detection of Iodine, by M. Carey Lea.

Where iodine exists in the form of hydriodic acid or the iodide of a base, two methods are commonly employed to put it into a condition to be detected by the starch test. One of these is by the action of nitric acid, the other by chlorine or bromine water; the latter is the more delicate, but has the disadvantage that if the chlorine or bromine be added in excess the reaction is missed.

It occurred to me while engaged in testing for iodine that the facility with which that body is eliminated from its hydrogen and metallic combinations by chromic acid would make the latter substance a valuable means of bringing about the starch reaction, and a few experiments completely confirmed this view.

If, for example, we take an extremely dilute solution of iodide of potassium, such that the addition of nitric acid and starch produces no perceptible effect, the further addition of a single drop of very dilute solution of bichromate of potash will instantly bring about the characteristic reaction. When chlorhydric acid is substituted for nitric, the effect of the bichromate is (as was to be expected) still more marked. The test has, then, the full delicacy at least of the chlorine test, with this great advantage, that an excess of the reagent does not prevent the reaction.

As to the delicacy of this test, the following observations were made:—With solutions of iodide of potassium up to $\frac{1}{100000}$th. the precipitate was abundant, becoming less blue and more tawny as the dilution increased. Beyond this point the distinctness rapidly fell off. The indications were observable at $\frac{1}{400000}$th. With a solution of $\frac{1}{800000}$th it was doubtful whether any effect was evident, though still it was thought that a darkening was produced. The experiment can be made in two ways, according to the result desired.

If it is wished to observe the effect of the chromic acid in increasing the delicacy of the indication, add the acid and starch to the very dilute solution of iodide, and then, when the extreme dilution is such that no reaction appears, a drop of solution of bichromate instantly produces it. But in employing the reagent in the search for iodine, add the starch to the liquid to be tested, stir it up, add a drop of dilute solution of bichromate, enough to communicate a pale yellow colour, and finally add a few drops of chlorhydric acid. The test is then the production of the characteristic precipitate, or in case of great dilution, approaching to a half-millionth, merely a tawny shade given to the solution.

It seems scarcely necessary to say that if a very great excess of acid is used, and too much bichromate, the starch may be made to reduce the bichromate. Even this, however, cannot deceive, for a bluish-green solution is thereby produced, whereas the indications of iodide are in the order of their strength — blue precipitate, tawny precipitate, tawny solution. Unless in the case of very exceptional dilution above spoken of, a well-marked blue precipitate is always obtained.

The examination of the delicacy of the reaction with very dilute solutions was made at a temperature of 65° F., or thereabouts. This fact requires to be taken into account, as according to some experiments of Fresenius, to be found in the *Jahresbericht* for 1857, the delicacy of the starch test increases as the temperature falls, so that at 0° C. a fainter trace can be rendered evident than at 12° C., and so on; the difference is asserted to be material. Fresenius's experiments were made with sulphuric acid and hyponitric acid, and the delicacy of the reaction obtained by him at corresponding temperatures seems to fall a little short of the above.—*Amer. Jour. of Science*, vol. xlii., No. 124.

TECHNICAL CHEMISTRY.

On a New Process in the Manufacture of White Lead, by* PETER SPENCE, *Esq.*

WHITE LEAD is one of the staple chemical products of almost first necessity. It has long been in use as the basis of nearly all the pigments employed in oil painting, few, if any, of the colouring bodies having the qualities that are required for painting in oil; and although, from its susceptibility to discoloration on the slightest contact with sulphuretted hydrogen and also from its poisonous character, substitutes for it have been eagerly sought after, as yet nothing has been found to supersede it. Anhydrous oxide of zinc has to a certain extent been introduced, but does not appear to make any way. It has not an equal covering quality with carbonate of lead; but its chief defect is its want of permanency. White lead forms an almost indestructible compound with the oil, while oxide of zinc forms only a mixture. The various modes that have more or less been adopted in the manufacture of white lead are historically known to those interested in chemical manufactures. Almost all of these processes are based on the action of acetic acid upon lead or lead oxide, with the exception of the process patented by Pattison in 1841, which is founded on the decomposition of galena by hydrochloric acid, the formation of chloride of lead, and the decomposition of the chloride by alkalies or by alkaline earths, such as lime or magnesia. Practically, this process is now confined to the production of oxychloride of lead, which seems to act with oil to a great extent like white lead. The oldest, most successful, and most generally practised mode of producing white lead, is that called the Dutch process; by this mode the object is accomplished by placing castings of pure lead of a suitable form one over another in stoneware pots, in the bottoms of which acetic acid or vinegar is poured; the pots are then loosely covered and piled in masses, the whole being then covered over with spent tan or some other slowly fermenting body, which will generate a small degree of heat for a considerable period. This evaporates the acetic acid, which acts on the lead, oxidising it and partially carbonating the oxide, and in about eight weeks the greater part of the lead is corroded and converted into oxide and carbonate of lead, the acetic acid is spent, and the crude lumps of white lead are ground. Any metallic lead left being picked out, and after washing, the article is ready for use. Nearly all the white lead now made in this country is by this mode. The German and Austrian process is the same in principle as the Dutch, but differs in detail. A good many attempts at the manufacture of white lead have been founded on the fact that acetate of lead in solution has the property of dissolving lead oxide, forming a basic compound.

My reasons for presenting to the Chemical Section of the British Association a process which may at first sight appear only as one of the many futile attempts to improve upon the established mode of producing white lead are two:—First, that the process is new, being in altogether a different direction from any attempt that I can find recorded, and although based upon a known law, yet that law never having been seen to point to this process, it is technologically a discovery. My second reason, is that a very important feature of the process as distinguished from all others is, that by it white lead can be manufactured from materials now useless. All other modes deal either with the purest metallic lead or equally pure oxide of lead. Pattison's process must deal either with the purest galena, free from iron or copper, or the chloride of lead must subsequently be freed from contamination by these metals or others, before it is used for the precipitating of oxychloride. By the process I shall now describe, any ore or mineral that contains eight or ten ounces of lead can be used for the production of white lead, and it is of no consequence what other metal the mineral contains; the process separates the lead directly without touching the other constituents of the mineral, and the white lead is perfectly pure. This being so, practically, I expect that all the white lead required may be made from ores or minerals now consigned to the rubbish heap as being too poor to work, and I know of large quantities of minerals useless as lead ores which will be economically adapted for the production of white lead. The process is based on the fact that oxide and carbonate of lead are soluble in solutions of caustic soda or potash, and are insoluble in the carbonates of these alkalies; the process, therefore, is effected by taking any mineral that contains oxide or carbonate of lead, or lead in any form that can by calcination or otherwise be converted into oxide or carbonate of lead, and by either macerating or boiling the mineral in a caustic solution all the lead is dissolved and extracted in a limpid and colourless solution. If the mineral contains oxide of iron, copper, or zinc, the caustic solution does not touch any of these oxides, and only attacks the lead. The lead solution has now passed into it carbonic acid gas, by which the alkali being carbonated, the lead is instantly precipitated as oxide and carbonate. The alkaline solution is now causticised by quick lime, and is ready for a second action on mineral containing lead oxide. The precipitated white lead has only to be washed to separate the solution of carbonated alkali, and then dried for use. A sample of it is on the table. It has been tried for painting, and is said by the painter, who had it used in various ways by his workmen, to be equal to any white lead he could procure. It has also been tried as a glaze in the potteries, and declared to be equal to any white lead the firm had in stock. As the process, at least in the laboratory, is a rapid one, if it would at all gratify the Section, I have the materials at hand, and can show it all in half an hour. The substance from which I shall now extract pure white lead had the following composition before calcination. I have brought the materials already calcined, as the calcination could not have been done here. Analysis—Zinc, 30·656; sulphur, 26·483; silica, 19·154; lead, 13·148; iron, 9·121; copper, 1·027; alumina, 0·216; silver, 0·022; moisture, 0·122; total, 99·949.

Mr. Spence then demonstrated by experiment the manufacture of white lead upon the principle given in the paper.

* Read before the British Association, Nottingham meeting.

In the discussion which followed, Professor Playfair said the precipitation of oxide of lead by carbonic acid was described upwards of twenty-five years ago by Thenard, and it was even carried into manufacturing process before; but it was abandoned on account of its being too crystalline and not sufficiently opaque. The plan, however, of getting oxide of lead out of minerals by means of alkaline solution was novel, and appeared to give promise of very useful application, whether the precipitate was found adapted to painting purposes or not.

PHYSICAL SCIENCE.

On the Refraction and Dispersion Equivalents of Chlorine, Bromine, and Iodine, by Dr.* Gladstone, *F.R.S.*

The refraction equivalent of a substance is the product of its atomic weight with its specific refractive index—that is, its refractive index minus one, divided by its density. Its dispersion equivalent is the difference between the refraction equivalents as calculated for the two extreme lines of the spectrum A and H. From data previously published by the author and the Rev. T. P. Dale, many determinations of these equivalents for chlorine, bromine, and iodine had been made. The following are from compounds of the halogens with methyl, ethyl, &c., and show that in each case the number for bromine lies between those for the other two:—

	Chlorine.	Bromine.	Iodine.
Refraction equivalent .	9·8	15·5	24·2
Dispersion „ .	0·5	1·3	2·6

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION.

Friday, June 8, 1866.

On the Source of Muscular Power, by Edward Frankland, *Ph.D., F.R.S., Professor of Chemistry, R.I.*

(Continued from page 140.)

There is still another circumstance which requires to be taken into consideration before we proceed to apply our three data to the solution of the problem before us. It is this—Is it possible that at the termination of the ascent of the Faulhorn there might be a considerable quantity of the nitrogenous products of decomposition retained in the body? Considering the physiological effect of the retention of urea in the system, as exemplified whenever the secretion of urine is interrupted, it is difficult to imagine the possibility of any considerable quantity of urea being retained in the system of a healthy man. It is, however, otherwise with creatin, another of the products of the metamorphosis of tissue; for it has been repeatedly shown that a muscle which has been hard worked contains more creatin than one that has been at rest. Thus the quantity of creatin contained in the heart of an ox was found to be ·14 per cent. (Gregory), and that in other ox-flesh only ·06 per cent. (Staedeler). Now the muscles which extend the leg in walking, and which do the essential work in ascending, have been estimated by Weber to weigh in both legs 5·8 kilograms, and if we assume that before the ascent these muscles contained ·06 per cent. of creatin, whilst after the ascent the percentage had increased to ·14 per cent., then the amount of creatin thus exceptionally retained would amount to 4·64 grams, which would be derived from 8·4 grams of muscle.

The speaker had been unable to determine the calorific effect of creatin, and consequently the actual energy developed by the transformation of muscle into creatin; for, although he was kindly furnished with an ample supply of this material by Dr. Dittmar, yet all attempts to burn it in the calorimeter were fruitless. Even when mixed in very small proportions with chlorate of potash and other combustibles of known value, the mixture invariably exploded violently on ignition. Although actual determination thus fails us, there can be no doubt that the transformation of muscle into creatin and other non-nitrogenous products must be attended by the liberation of far less actual energy than its transformation into urea, carbonic acid, and water. To be convinced of this, it is only necessary to compare (under equal nitrogen value) the formulæ of muscle, creatin, and urea, remembering at the same time that the nitrogen probably possesses no thermal value, and that each atom of oxygen destroys approximately the thermal effect of two atoms of hydrogen.

	Comparable formulæ.	Powerful or unburnt matter.
Muscle . .	$C_{24}\ H_{37}\ N_6\ O_7$	$C_{24}\ H_{23}$
Creatin . .	$C_8\ H_{18}\ N_8\ O_4$	$C_8\ H_{10}$
Urea . .	$C_3\ H_{12}\ N_8\ O_3$	$C_3\ H_6$

Thus it is evident that the amount of creatin exceptionally retained in the system could not greatly affect the result of the experiment as regards the possible amount of actual energy derivable from the metamorphosed tissues during the ascent; firstly, on account of the small quantity of creatin so retained, and, secondly, because creatin still contains about one-third of the potential energy of the muscle from which it is derived. But as this point cannot be experimentally demonstrated, the speaker followed the example of Fick and Wislicenus, and made a very liberal allowance on this score. He allowed, as they had done, that the whole of the nitrogen secreted during the six hours after the ascent was exceptionally retained in the system *as urea* during the ascent. This is equivalent to an admission that the muscles of the legs contained at the end of the ascent eleven times as much creatin as was present in them before the ascent. In the above tabular statement of results provision has been made for this allowance by adding together, on the one hand, the amounts of nitrogen secreted during the ascent and six hours after it, and, on the other, the weights of dry muscle corresponding to these two amounts of nitrogen.

Having thus far cleared the ground, let us now compare the amount of measured and calculated work performed by each of the experimenters during the ascent of the Faulhorn, with the actual energy capable of being developed by the maximum amount of muscle that could have been consumed in their bodies, this amount being represented by the total quantity of nitrogen excreted in each case during the ascent and for six hours afterwards.

	Fick. Grams.	Wislicenus. Grams.
Weight of dry Muscle consumed .	37·17	37·00
	Metrekilo-grams.	Metrekilo-grams.
Actual energy capable of being produced by the consumption of 37·17 and 37·00 grams of dry Muscle in the body	68,690	68,376
Measured work performed in the ascent (external work)	129,096	148,656
Calculated circulatory and respiratory work performed during the ascent (internal work)	30,541	35,631
Total ascertainable work performed .	159,637	184,287

It is thus evident that the muscular power expended by these gentlemen in the ascent of the Faulhorn could not be exclusively derived from the oxidation, either of their

* Read before the British Association, Nottingham meeting.

muscles, or of other nitrogenous constituents of their bodies, since the maximum of power capable of being derived from this source even under very favourable assumptions is, in both cases, less than one-half of the work actually performed. But the deficiency becomes much greater if we take into consideration the fact that the actual energy developed by oxidation or combustion cannot be wholly transformed into mechanical work. In the best constructed steam-engine, for instance, only one-tenth of the actual energy developed by the burning fuel can be obtained in the form of mechanical power; and in the case of man, Helmholtz estimates that not more than one-fifth of the actual energy developed in the body can be made to appear as external work. The experiments of Haidenhain, however, show that, under favourable circumstances, a muscle may be made to yield in the shape of mechanical work as much as one-half of the actual energy developed within it, the remainder taking the form of heat. Taking, then, this highest estimate of the proportion of mechanical work capable of being got out of actual energy, it becomes necessary to multiply by 2 the above numbers representing the ascertainable work performed, in order to express the actual energy involved in the production of that work. We then get the following comparison of the actual energy capable of being developed by the amount of muscle consumed, with the actual energy necessary for the performance of the work executed in the ascent of the Faulhorn.

	Fick. Metre-kilograms.	Wislicenus. Metre-kilograms.
Actual energy capable of being produced by Muscle metamorphosis .	68,690	68,376
Actual energy expended in work performed	319,274	368,574

Thus, taking the average of the two experiments, it is evident that scarcely one-fifth of the actual energy required for the work performed could be obtained from the amount of muscle consumed.

Interpreted in the same way, previous experiments of a like kind prove the same thing, though not quite so conclusively. To illustrate this I will here give a summary of three sets of experiments; the first, made by Dr. E. Smith, upon prisoners engaged in treadmill labour; the second, by the Rev. Dr. Haughton, upon military prisoners engaged in shot drill; and the third, adduced by Playfair and made upon pedestrians, piledrivers, men turning a winch, and other labourers.

Treadwheel Experiments.

A treadwheel is a revolving drum with steps placed at distances of 8 inches, and the prisoners are required to turn the wheel downwards by stepping upwards. Four prisoners, designated below as A, B, C, and D, were employed in these experiments, and each worked upon the wheel in alternate quarters of an hour, resting in a sitting posture during the intervening quarters. The period of actual daily labour was 3½ hours. The total ascent per hour 2160 feet, or per day 1·432 mile. The following are the results:—

Treadwheel Work.—(E. Smith.)

	Weight in Kilo-grams.	Ascent in Metres.	Days occupied in Ascent.	External work performed in Metrekilo-grams.	Total Nitrogen evolved.	Weight of dry Muscle corresponding to Nitrogen.
					Grams.	Grams.
A	47·6	23,045	10	1,096,942	171·3	1101·2
B	49	23,045	10	1,129,205	174·5	1121·7
C	55	20,741	9	1,140,755	168·0	1080·1
D	56	20,741	9	1,161,496	159·3	1024·3

In these experiments the measured work was performed in the short space of three hours and a half, whilst the nitrogen estimated was that voided in the shape of urea in twenty-four hours. It will, therefore, be necessary to add to the measured work that calculated for respiration and circulation for the whole period of twenty-four hours. This amount of internal work was computed, from the estimates of Helmholtz and Fick, to be as follows:—

Internal Work.—(Helmholtz and Fick.)

	Work performed. Metrekilograms.	Actual energy required. Metrekilograms.
Circulation of the blood during 24 hours, at 75 pulsations per minute	69,120*	138,240
Respiration for 24 hours, at 12 respirations per minute .	10,886	21,772
Statical activity of muscles	not determd.	not determd.
Peristaltic motion . . .	„ „	„ „
	80,006	160,012

Taking this estimate for internal work, the average results of the treadwheel experiments may be thus expressed:—

Treadwheel Work.

Average external work per man per day		119,605 mks.
Average nitrogen evolved per man per day		17·7 grams.
Weight of dry muscle corresponding to average nitrogen evolved per day .		114 „
Actual energy producible by the consumption of 114 grams of dry muscle in the body		210,672 mks.
Average actual energy developed in the body of each man, viz.:—		
External work 119,605 × 2 = 239,210		„
Circulation . 69,120 × 2 = 138,240		„
Respiration . 10,886 × 2 = 21,772		„
	399,222	„

In these experiments the conditions were obviously very unfavourable for the comparison of the amount of actual energy producible from muscle metamorphosis with the quantity of actual energy expended in the performance of estimable work; since, during that portion of the twenty-four hours not occupied in the actual experiment, a large amount of unestimable internal work, such as the statical activity of the muscles, peristaltic motion, &c., was being performed. Nevertheless, these experiments show that the average actual energy developed in producing work in the body of each man was nearly twice as great as that which could possibly be produced by the whole of the nitrogenous matter oxidised in the body during 24 hours. It must also be remarked that the prisoners were fed upon a nitrogenous diet containing six ounces of cooked meat, without bone; a diet which, as is well known, would favour the production of urea.

Shot-drill Experiments.

The men employed for these experiments were fed exclusively upon vegetable diet, and they consequently secreted a considerably smaller amount of nitrogen than the flesh-eaters engaged in the treadwheel work. The other conditions were, however, equally unfavourable for showing the excess of work performed over the amount derivable from muscle metamorphosis.

In shot-drill, each man lifts a 32 lb. shot from a tressel to his breast, a height of 3 feet; he then carries it a distance of 9 feet, and lays it down on a similar support, returning unloaded. Six of these double journeys occupy one minute. The men were daily engaged with—

Shot drill	3 hours
Ordinary drill . . .	1¼ „
Oakum picking . .	3½ „

The total average daily external work was estimated by Haughton at 96,316 metrekilograms per man.

* Since making use of this number, I find that Donders estimates the work of the heart alone, for 24 hours, at 86,000 metrekilograms, a figure which is higher than that above for the combined work of circulation and respiration.

The following is a condensed summary of the results of these experiments:—

Military Vegetarian Prisoners at Shot Drill.—(Haughton.)

Average external work per man per day	96,316	mks.
Average nitrogen evolved per man per day	12·1	grams.
Weight of dry muscle corresponding to average nitrogen evolved per day	77·9	,,
Actual energy producible by the consumption of 77·9 grams of dry muscle in the body	143,950	mks.
Average actual energy developed daily in the body of each man, viz.:—		
External work, 96,316 × 2 = 192,632		,,
Internal work 160,012		,,
	352,644	,,

Owing chiefly to the vegetable diet of these prisoners, the result is more conclusive than that obtained upon the treadwheel, the amount of work actually performed being considerably more than twice as great as that which could possibly be obtained through the muscle metamorphosis occurring in the bodies of the prisoners.

Playfair's Determinations.

In these determinations the number 109,496 metre-kilograms was obtained as the average amount of daily work performed by pedestrians, pile-drivers, porters, paviors, &c.; but, as the amount of muscle consumption is calculated from the nitrogen taken in the food, the conditions are as unfavourable as possible with regard to the point the speaker was seeking to establish; for it is here assumed, not only that all the nitrogen taken in the food enters the blood, but also that it is converted into muscle, and is afterwards oxidised to carbonic acid, water, and urea.

The following are the results expressed as in the previous cases:—

Hard-worked Labourer.—(Playfair.)

	Work performed. Mks.	Actual energy required. Mks.
Daily labour (external work)	109,496	218,992
Internal work	80,006	160,012
	189,502	379,004
Actual energy capable of being produced from 5·5 oz. (155·92 grams) of flesh-formers contained in the daily food of the labourer		288,140

Thus, even under the extremely unfavourable conditions of these determinations, the actual work performed exceeded that which could possibly be produced through the oxidation of the nitrogenous constituents of the daily food by more than 30 per cent.

We have seen, therefore, in the above four sets of experiments, interpreted by the data afforded by the combustion of muscle and urea in oxygen, that the transformation of tissue alone cannot account for more than a small fraction of the muscular power developed by animals; in fact, this transformation goes on at a rate almost entirely independent of the amount of muscular power developed. If the mechanical work of an animal be doubled or trebled, there is no corresponding increase of nitrogen in the secretions; whilst it was proved on the other hand by Lawes and Gilbert, as early as the year 1854, that animals, under the same conditions as regarded exercise, had the amount of nitrogen in their secretions increased twofold by merely doubling the amount of nitrogen in their food. Whence, then, comes the muscular power of animals? what are the substances which, by their oxidation in the body, furnish the actual energy, whereof a part is converted into muscular work? In the light of the experimental results detailed above, can it be doubted that a large proportion of the muscular power developed in the bodies of animals has its origin in the oxidation of non-nitrogenous substances? for whilst the secretion of nitrogen remains nearly stationary under widely different degrees of muscular exertion, the production of carbonic acid increases most markedly with every augmentation of muscular work, as is shown by the following tabulated results of E. Smith's highly important experiments regarding the amount of carbonic acid evolved from his own lungs under different circumstances.†

Excretion of carbonic acid during rest and muscular exertion:—

	Carbonic acid per hour.
During sleep	19·0 grams.
Lying down and sleep approaching	23·0 ,,
In a sitting posture	29·0 ,,
Walking at rate of 2 miles per hour	70·5 ,,
,, ,, 3 ,, ,,	100·6 ,,
On the treadwheel, ascending at the rate of 28·65 feet per minute	189·6 ,,

It has been already stated as a proposition upon which all are agreed, that food, and food alone, is the ultimate source from which muscular power is derived; but the above determinations and considerations, the speaker believed, prove conclusively, firstly, that the non-nitrogenous constituents of the food, such as starch, fat, &c., are the chief sources of the actual energy, which becomes partially transformed into muscular work; and secondly, that the food does not require to become organised tissue before its metamorphosis can be rendered available for muscular power; its digestion and assimilation into the circulating fluid—the blood—being all that is necessary for this purpose. It is, however, by no means the non-nitrogenous portions of food alone that are capable of being so employed; the nitrogenous also, inasmuch as they are combustible, and consequently capable of furnishing actual energy, might be expected to be available for the same purpose, and such an expectation is confirmed by the experiments of Savory upon rats,‡ in which it is proved that these animals can live for weeks in good health upon food consisting almost exclusively of muscular fibre. Even supposing these rats to have performed no external work, nearly the whole of their internal muscular work must have had its source in the actual energy developed by the oxidation of their strictly nitrogenous food.

It can scarcely be doubted, however, that the chief use of the nitrogenous constituents of food is for the renewal of muscular tissue; the latter, like every other part of the body, requiring a continuous change of substance, whilst the chief function of the non-nitrogenous is to furnish by their oxidation the actual energy which is in part transmuted into muscular force.

The combustible food and oxygen coexist in the blood which courses through the muscle, but when the muscle is at rest there is no chemical action between them. A command is sent from the brain to the muscle, the nervous agent determines oxidation. The potential energy becomes active energy, one portion assuming the form of motion, another appearing as heat. Here is the source of animal heat, here the origin of muscular power! Like the piston and cylinder of a steam-engine, the muscle itself is only a machine for the transformation of heat into motion; both are subject to wear and tear and require renewal, but neither contributes in any important degree by its own oxidation to the actual production of the mechanical power which it exerts.

From this point of view it is interesting to examine the various articles of food in common use, as to their capabilities for the production of muscular power. The speaker had therefore made careful estimations of the calorific value of different materials used as food, by the same apparatus and in the same manner as described above

† *Phil. Trans.* for 1859, p. 709.

‡ The *Lancet*, 1863, pages 381 and 412.

for the determination of the actual energy in muscle, urea, uric acid, and hippuric acid.

The results are embodied in the following series of tables, but it must be borne in mind that it is only on the condition that the food is digested and passes into the blood, that the results given in these tables are realised. If, for instance, sawdust or paraffin oil had been experimented upon, numbers would have been obtained for these substances, the one about equal to that assigned to starch, and the other surpassing that of any article in the table; but these numbers would obviously have been utterly fallacious, inasmuch as neither sawdust nor paraffin oil is, to any appreciable extent, digested in the alimentary canal. Whilst the force values experimentally obtained for the different articles in these tables must therefore be understood as the maxima assignable to the substances to which they belong, yet it must not be forgotten that a large majority of these substances appear to be completely digestible under normal circumstances.

Actual Energy developed by One Gram of Various Articles of Food when burnt in Oxygen.

Name of Food.	Heat units.		Metrekilograms of force.		Percent. of water.
	Dry.	Natural condition.	Dry.	Natural condition.	
Cheese (Cheshire)	6114	4647	2589	1969	24·0
Potatoes	3752	1013	1589	429	73·0
Apples	3669	660	1554	280	82·0
Oatmeal	...	4004	...	1696	...
Flour	...	3941	...	1669	...
Pea-meal	...	3936	...	1667	...
Ground rice	...	3813	...	1615	...
Arrowroot	...	3912	...	1657	...
Bread crumb	3984	2231	1687	945	44·0
Ditto crust	...	4459	...	1888	...
Beef (lean)	5313	1567	2250	664	70·5
Veal ,,	4514	1314	1912	556	70·9
Ham ,,	4343	1980	1839	839	54·4
Mackerel	6064	1789	2568	758	70·5
Whiting	4520	904	1914	383	80·0
White of egg	4896	671	2074	284	86·3
Hard-boiled egg	6321	2383	2677	1009	62·3
Yolk of egg	6460	3423	2737	1449	47·0
Gelatin	4520	...	1914	...	...
Milk	5093	662	2157	280	87·0
Carrots	3767	527	1595	223	86·0
Cabbage	3776	434	1599	184	88·5
Cocoa nibs	..	6873	...	2911	...
Beef fat	9069	...	3841	...	...
Butter	...	7264	...	3077	...
Cod-liver oil	...	9107	...	3857	...
Lump sugar	...	3348	...	1418	...
Commercial grape sugar	...	3277	...	1388	...
Bass's ale (alcohol reckoned)	3776	775	1599	328	88·4
Guinness's stout	6348	1076	2688	445	88·4

(To be continued.)

ACADEMY OF SCIENCES.

September 17.

THE following papers were brought forward:—

M. Payen, "*On the Composition and Economical Use of Two Species of Vegetable Leguminous Seeds in China.*" These are used as detergents in many parts of China where soap is unknown. They belong to a *Dialium*, and contain a natural soap, which communicates the property of frothing to water under agitation.

T. Graham, "*On the Absorption and Dialytic Separation of Gases by means of Colloid Diaphragms.*" This paper has already been before our readers.

M. A. d'Abbadie, "*On Hypsometry.*"

M. Dancel, "*On the Influence of Water and Liquid Food on the Production of Milk.*" This is a valuable paper from a cowkeeper's point of view, although we don't think the author can teach our London tradesmen much. He finds that by causing cows to drink more water, by exciting their palates with salt, he can increase the yield of milk several quarts a day without injuring its quality. But in order to do this the cow must be made to drink 20 to 25 quarts of water a day beyond her customary quantity. It therefore becomes a question whether the plan adopted in London is not better—that of adding the desired quantity of water to the milk *after* it leaves the cow instead of pouring six times the needful quantity down the unfortunate animal's throat. As far as regards the question of adulteration, there cannot be much difference between the two plans.

M. J. Riban, "*On Coriamyrtine and its Derivatives.*"

M. Delerue wrote in praise of *bicarbonate of magnesia*, as being the most energetic antidote against the cholera poison.

M. Berthelot, "*On the Polymeres of Acetylene. First Part—Synthesis of Benzol.*" This is a very important paper, and we intend to give it in full in an early number. The author shows that one litre of benzol vapour contains the same elements as three litres of acetylene—

$$C_{12}H_6 = 3C_4H_2.$$

By passing acetylene through a red-hot tube, he finds that a yellowish liquid is produced in small quantity, which contains benzol, styrol, fluorescent carbides, retene, &c. The benzol has been studied minutely, and is found to agree in every respect with ordinary benzol.

M. A. Leplay, "*On a New Liquid Pulveriser by means of Carbonic Acid Gas.*"

M. M. de Brettes, "*On the Influence of the Rotation of the Earth on the Deviation of Projectiles from Rifled Ordnance.*" He finds that this influence may become sufficiently great to be taken into consideration and receive useful applications in the artillery service.

C. Mène, "*Analysis of the Principal Marbles of Jura.*"

M. F. Plateau, "*On the Vision of Fishes and Amphibia.*"

M. Guérin-Méneville, "*The Principal Localities where the Culture of the Ailanthus Silkworm has commenced to be developed.*"

M. C. Decharme, "*On the Solar Halo observed at Angers, August 30, 1866.*"

M. G. Rayet, "*On the Earthquake of September 14, 1866.*" This is accompanied by a lithographed chart, showing the localities where the phenomenon was noticed and the direction and number of shocks.

Preparation of Pure Caustic Alkalies.—M. Graeger, having brought the alkaline carbonates to such a state of purity that they only contain traces of chlorides, first treats them with carbonate of silver, and then boils them with lime from calcined marble. The ley is then filtered through a funnel, in the bottom of which are placed fragments of marble and powdered marble, first pouring distilled water through till it passes perfectly limpid.—*Journal für praktische Chemie.*

Detection of Free Sulphuric Acid in Acetic Acid or Vinegar.—Boil about 50 cubic centimetres of the acid to be tested in a retort with a very small quantity of starch, until half the liquid is distilled; after it has cooled add a drop of tincture of iodine. If, under these circumstances, a blue coloration be produced, no sulphuric acid is present. If the blue colour does not appear, it may be concluded that sulphuric acid is present, which, by reacting on the starch, will have transformed it to glucose. With tincture of iodine, glucose gives no particular coloration. Sulphuric acid, thus detected, may be estimated by the ordinary processes.—*Boettger's polytechnisches Notizblatt.*

NOTICES OF BOOKS.

On Crystal Cod-liver Oleine. By J. and A. Bedford. London: 155, Leadenhall Street.

This essay is published for the purpose of making known a new importation of cod-liver oil, which, for the sake of distinguishing it by its properties of colour and transparency, as well as by its composition, is named by the proprietors "Crystal Cod-liver Oleine." The writers disclaim for it any specific curative virtue over other first-rate specimens of cod-liver oil, but urge that, while it possesses all the therapeutic value of any other similar oil, it has properties of its own which render it peculiarly advantageous. They say that it is refined by a new and effective process; that being expressed and refined from the fresh liver of the fish, there is in it no trace of decomposing organic matter, nor of volatile product of decomposition; that it is free from fishy or other disagreeable odour, and that the sense of smell of the most delicate person cannot be affected by it in the least degree. Further, the writers say, the oil is entirely free from rancidity—almost tasteless—drinks as blandly as new milk, and leaves no unpleasant flavour behind. The oleine has been submitted to physicians of practical experience and judgment, and proved to be not only of first quality in a medicinal sense, but, as an oil, more agreeable to patients than any that has been before imported.

Bibliothèque Universelle et Revue Suisse. Archives des Sciences Physiques et Naturelles. No. 102. June 25.

The only original paper in this number which in any way bears upon chemistry or physics, is one by M. Marignac, "*On the Combinations of Tantalum.*" The author had already come to the conclusion that the formula of tantalic acid was Ta_2O_5. These new researches entirely confirm this view. The greater part of the tantalic acid used in these experiments was obtained from the columbite of Haddam, which contains 31·5 per cent. of it. The *atomic weight* was determined by treating perfectly pure fluotantalate of potash by pure strong sulphuric acid; gradually drive off the excess of acid, and finally heat to 400° C. Boil with water, which dissolves the bisulphate of potash and leaves the tantalic sulphate in small granular crystals; these by strong calcination leave tantalic acid. This gave $Ta = 182·3$ and $Ta_2O_5 = 444·6$. Tantalic acid has a density of 7·60 to 7·64. There are two modifications: one monobasic, which yields salts of the composition

$$MO,Ta_2O_5$$

(to this type the tantalites belong), and another quadribasic, giving salts,

$$4MO,3Ta_2O_5.$$

The tantalates of potash and soda belong to this type; they crystallise well. The *brown oxide of tantalum*, TaO_2, is obtained by heating the acid in a charcoal crucible. *Sulphide of tantalum*, TaS_2, is formed by strongly heating tantalic acid in bisulphide of carbon vapour. *Chloride of tantalum*, $TaCl_5$, ought, according to M. Marignac, have a vapour density of 12·84, but M. Deville found it to be much less. We understand, however, that more recent determinations, made since M. Marignac's paper was written, have yielded in M. Deville's hands the density of 12·42. The results are the same whether operating at a temperature of 350° or 440° C. The determination quoted by M. Marignac was performed on a chloride containing niobium. Tantalic acid dissolved in hydrofluoric acid gives soluble and well-crystallised fluosalts. Fluoxytantalates, analogous to fluoxyniobates, do not appear to exist. *Fluotantalate of potash*, $TaFl_5,2KFl$, crystallises in right rhombic prisms: by prolonged ebullition it changes to an insoluble salt, $Ta_2O_5 + 2(2KFl,TaFl_5)$. The formation of this insoluble salt gives a means of detecting the smallest quantity of fluotantalate in fluoxyniobate of potash. The fluotantalates of soda, ammonia, zinc, and copper are also described. All the fluotantalates obtained by the author belong to the same type. There can now remain no longer any doubt as to the composition of fluoride of tantalum, and of tantalic acid.

Among the extracts from foreign journals given in this number we find the following:—

Prof. Ryhe "*On the Diffusion of Gases through Caoutchouc.*" The author finds that when hydrogen gas is passed through india-rubber tubes it always contains traces of air and aqueous vapour. MM. Aronstein and Sirks examined this more fully, and found that common vulcanised, brown devulcanised, and pure non-vulcanised caoutchouc were all easily pervious to hydrogen, but that they could be rendered impermeable by a coating of asphalt dissolved in coal oil.

Prof. Rammelsberg "*On the Lower Degrees of Oxidation of Molybdenum.*" Molybdic acid reduced by hydrogen gives first the blue oxide, then the brown (MoO_2), and lastly the metal. Zinc in a solution of molybdic acid or molybdate of ammonia in presence of *aqua regia* gives a sesquioxide of molybdenum. Other oxides are given, and their mode of preparation described. The series is as follows:—

$$Mo_2O_3$$
$$MoO_2$$
$$MoO_3$$
$$Mo_2O_5 = MoO_2, MoO_3$$
$$Mo_3O_8 = MoO_2, 2MoO_3$$
$$Mo_3O_{14} = MoO_2, 4MoO_3.$$

Chemisches Central Blatt. Nos. 38, 39, and 40.

No original paper is to be found in any of these numbers. No. 38 contains articles by—

O. L. Erdmann, "*On the Double Nitrites of Nickel and Potash;*"

Dr. K. Frisch, "*On the Atomicity of Tartaric Acid;*"

Dr. C. Winkler, "*On Colorific Estimation of Cobalt and Nickel.*"

All these are from the *Journ. für prakt. Chem.*, noticed in our number for July 20.

Nos. 39 and 40 go still further back, and devote 17 pages to an article by—

Dr. A. Remelé, "*On the Sulphur Compounds of Uranium,*" which we noticed in May last. The other articles are by—

E. Linnemann, "*On the Production of Glycerin from Trichlorhydrin;*"

F. Wöhler, "*On a new Mineral from Borneo,*"

$$12(Ru_2S_3) + OsS_4$$

Described in our number for May 25 last;

Dr. U. Hallwachs, "*On the Estimation of Tannic Acid in Substances containing it.*"

The usual short notices of papers contributed to other journals are given at the end of each number.

Journal für praktische Chemie. No. 12. July, 1866.

This number contains articles by—

R. L. Maly, "*On an Ether of Tungstic Acid.*" The author thought that an examination of tungstic ether would serve to fix the atomic weight of tungsten. As is well known, this ether has not yet been prepared either by reacting on an acid ether by a compound of tungstic acid, or by mixing iodide of ethyl with tungstate of silver. M. Maly succeeded in forming it by causing alcohol to react on the oxychloride of tungsten, WCl_2O (or $\overset{W}{\underset{W}{}}Cl_4O$), which sublimes in beautiful cinnabar-red glittering needles. By adding this to strong alcohol and agitating, the mixture, at first clear, gradually becomes turbid, and in a short time there is an abundant white flocculent precipitate. In 24 hours filter, and wash with alcohol till the acid re-

action has disappeared; then dry in the air, and afterwards over sulphuric acid. Tungstic ether forms a hard, brittle, glassy mass, insoluble in water, alcohol, and ether; heated on platinum, it decomposes with a smoky flame, leaving a black mass which ultimately burns to yellow tungstic acid. The author gives to it the following formula:—

$$\mathrm{W_2O_5}\left\{\begin{matrix}\mathrm{H}\\ \mathrm{C_2H_5}\end{matrix}\right\}\mathrm{O}+\mathrm{H_2O}.$$

A. Cahours, "*On the Sulphuretted Radicals.*" An abstract of this paper appeared in the Chemical News in June 1865.

"*On the Products of the Distillation of Lactate of Lime.*"

R. Otto, "*On the Reaction between Sulphobenzid and Chloride of Phosphorus.*" The author finds that the products are monochlorobenzol and sulphochlorobenzol.

$$\left.\begin{matrix}\mathrm{C_{12}H_5}\\ \mathrm{S_2O_4}\\ \mathrm{C_{12}H_5}\end{matrix}\right\}+\mathrm{PCl_5}=\left.\begin{matrix}\mathrm{C_{12}H_5}\\ \mathrm{Cl}\end{matrix}\right\}+\left.\begin{matrix}\mathrm{C_{12}H_5}\\ \mathrm{S_2O_4}\\ \mathrm{Cl}\end{matrix}\right\}+\mathrm{PCl_3}$$

Dr. F. Rochleder, "*On the Constituents of the Root-bark of Apple-trees,*" and "*On the Leaves of the Epacris.*"

O. Reinhold, "*On Aloisol,*" and "*On the Preparation of Chloride of Succinyl from Oil of Bitter Almonds.*"

H. Hlasiwetz, "*On Scoparin.*" "*On the Purification of Iodide of Potassium and its Action on Starch.*"

All the other papers in this number are from the *Comptes-Rendus*, or English journals, and have already been fully noticed in our pages.

NOTICES OF PATENTS.

No. 85. *An Improved Method of producing Oxygen.* A communication by Charles Raphael Maréchal and Cyprien Marie Tessié du Motay, of Metz, France. Dated January 10, 1866.

The patentees state that manganates and permanganates of potassa, soda, and baryta, ferrates of potassa, soda, and baryta, chromates of potassa, soda, and baryta, and in general all metallic oxides or acids which will form with potassa, soda, and baryta binary combinations capable of superoxidising, possess the property of yielding their oxygen at a more or less elevated temperature when they are submitted to the action of a current of steam. These bodies thus deoxidised also possess the property of becoming reoxidised when they are exposed to the action of a current of air at a temperature more or less great. The present invention, consisting in the direct production of oxygen by means of atmospheric gas, is based upon the double property just cited. The patentees place in a retort or other distillatory vessel one of the binary compounds above mentioned, whether at the minimum or at the maximum state of oxidation. If the binary compound is at the minimum state of oxidation, they superoxidise it by means of a current of air drawn or impelled mechanically, or drawn by a chimney serving the purpose of producing draught. If the compound is at the maximum state of oxidation, they deoxidise it by means of a current of steam or by injecting water; the oxygen and the steam on issuing from the retort pass together into a condenser; the steam is condensed, and the oxygen passes on to a gasholder in which it is collected. When all the utilisable oxygen contained in the binary compound has been disengaged by the action of the steam, the operation of superoxidation by means of air is recommenced, and *vice versâ*. The production of oxygen is continued in this alternate manner as long as may be required.

This patent is said by report to be at work very successfully in France. If the reactions proceed in practice with as great regularity as would appear from the above description, there is no doubt that this is a very valuable invention, and one which will be applied to many metallurgical processes.

97. *Preparing Tetrachloride of Carbon.* Charles Crump, Yealmpton, Devon. Dated January 11, 1866.

The inventor dissolves iodine in bisulphide of carbon, the latter being contained in a retort or other suitable vessel, and the solution being kept in a cool state by being surrounded by water, or by any other suitable means. He then passes dry chlorine gas into the liquid so prepared as long as it is taken up or absorbed thereby, or until crystals of chloride of iodine appear in the retort or other vessel employed. The compound thus formed consists of a mixture of tetrachloride of carbon and chloride of sulphur, which is then digested with excess of sulphur in order to convert the higher chlorides of sulphur which are present into protochloride. The tetrachloride of carbon is afterwards partially separated by distillation, and the distillate purified by treatment with water or milk of lime or potash ley, or in any other suitable manner. In some cases, especially when a sufficient amount of chlorine has not been passed into the solution of iodine in the bisulphide of carbon as before mentioned, it may be necessary after purifying the tetrachloride of carbon to complete the purification by dissolving in it a fresh quantity of iodine, and passing in a small additional quantity of chlorine. A very small quantity of iodine is sufficient to effect the decomposition of an unlimited amount of bisulphide of carbon, but it will be found desirable to proportion the quantity of iodine to the rapidity with which the chlorine is passed into the liquid, so that there shall be enough iodine present to cause the whole of the chlorine to be absorbed with facility. Bromine may be employed instead of iodine for the purposes of this invention.

This process is not only valuable as a patent, but is based upon a new chemical principle, which appears capable of great extension.

169. *Improvements in the Combination of Chemical Matters and Mechanical Apparatus applied therewith for the Prevention or Cure of Contagious and other Diseases to which Human Beings and Animals are Subject.* William Hibbert, Manchester. Dated January 18, 1866.

This invention consists, firstly, of a compound solution to be used internally as a medicine or outwardly as baths, embrocations, or saturated bandages; it also acts as a disinfectant and preventive agent against infectious diseases generally. Secondly, of mechanical apparatus for filtering, purifying, and disinfecting the polluted air or atmosphere in infected situations. It is said to be particularly applicable to preventing and arresting the progress of fermentation and decomposition in the blood of human beings or animals, as in the cases of rinderpest, fevers, scrofula, mortification, glanders, mange, running sores, and other diseases arising from an unhealthy state of the blood.

The said compound consists of chlorides of magnesium, bromine, and zinc, either separately or in any combination. The patentee takes chloride of magnesium in solution at about 40° Twaddell, adds from one to two ounces of bromine to a gallon of the said solution, and in some cases from five to ten per cent of chloride of zinc. For human beings ten to twenty drops in a wineglass of pure water will be a sufficient dose for an adult, to be repeated as the case may require. For cattle one or two ounces of the solution with five to ten per cent. of chloride of zinc added may be given in a pint of water, or as much water as the beast will drink, but these proportions may be varied according to the virulence of the disease.

For outward application, as baths or embrocations, the said solution may be freely applied; also painless bandages, which do not stick to the skin when taken off, are obtained by impregnating cloth with the above solution. By increasing the chloride of zinc to from eleven to twenty per cent., it may also be freely used as a disinfectant for hospitals, barracks, holds of ships, railway trucks, or

similar places. He also uses chlorides of magnesium and bromine for preserving animal matter for shipment as food, the strength to be about 16° Twaddell.

The mechanical apparatus consists of an auxiliary lung respirator, which he makes of leather or other suitable material, and of any suitable conformation to suit cattle or human beings.

The improved air-disinfecting filter is attached or not to a reserve chamber from which the respiratory organs are supplied with disinfected air, and consists of a box sufficiently large to supply one or more subjects, in which box are inserted a number of tubes which conduct the air through the disinfecting solution, after which it rises through charcoal, coke, or other material saturated with the same solutions, and through a sieve or perforated plate into the reserve chamber. He also employs, when desired, another filter of similar construction to the above for disinfecting the exhaled air before it passes into the atmosphere.

For feeding, the patentee partitions off the front part of the stall with an opening to admit the head, which opening is enclosed by air-proof or disinfecting cloth surrounding the neck of the animal, the purified air being supplied by a valve connected with the air chamber, and the exhaled air passes through a valve into the above-named disinfecting filter before its arrival into the open air. The above appliances procure isolation of the respiratory organs.

For safe removal or perambulation he couples to the valves short tubes with disinfecting filters inserted therein, one for the prevention of receiving the infected air, and the other to prevent its communicating infection.

The method for preventing contagion being communicated or received through the medium of the skin is by clothing, surrounding, or bandaging the animal with cloth or other suitable material impregnated with the above-named disinfecting solution or solutions, or by impregnating the skin with the same, by which isolation from the infection of the atmosphere by which they are surrounded is obtained. Small doses of the said solution occasionally given to healthy animals will lessen the violence of an attack of rinderpest or other contagious disease, if not throw off the influence altogether without isolation.

This patent is very amusing, and the fact of its having been proceeded with is a strong argument for the appointment of scientific examiners to inquire into the claims of a would-be patentee. We have here a patent for the use of chloride of magnesium, bromine, and chloride of zinc, either separately or in combination, as a medicine for all diseases arising from an unhealthy state of the blood. What on earth is to prevent some one else from taking out another patent to-morrow for the use of sulphate of magnesia as a remedy for another affliction to which the sedentary portion of humanity is supposed to be peculiarly liable? The patentee of the latter would be tolerably certain to meet with infringements, an annoyance to which we can safely promise Mr. Hibbert will not be subject.

Recipes for Copying Ink.—(1.) 3 parts by weight of white glycerine; 3 do. of purified white honey, best quality; 10 do. of violet, black, or other coloured ink. Mix up well, and leave the mixture to settle two or three days before using. (2.) 4 parts by weight of white glycerine; 4 do. of purified white honey, best quality; 10 do. of Robertson's ink; ¼ do. of powdered gum arabic. Add one or two drops of strong solution of bichloride of mercury to prevent deterioration of the ink; stir up well, and leave it to settle for two or three days before using. If it should be found, in taking copies from inks according to Recipe No. 1, that thicker characters are produced than those of the original, the proportions of glycerine and honey may be respectively reduced to 2 parts of each, or another quarter by weight of 1 part powdered gum arabic may be added.—*Chemical Technology.*

CORRESPONDENCE.

Composition of the Solar Spectrum.

To the Editor of the Chemical News.

Sir,—You are probably aware of Sir David Brewster's investigation into the nature of the solar spectrum by examining it through coloured liquids and glasses, and the theory he formed to account for the facts he observed. You are also probably aware of the manner in which these investigations were received in France, more especially by Helmholtz and Bernard—viz., that they were not exact experiments, and that he had diffused and confused light and contrasts of colour that he did not take into account, which vitiated his experiments and consequently his conclusions.

Seeing such an account in some back numbers of the *Photographic Journal*, and being unable to ascertain whether Sir David Brewster has written anything in reply, I shall feel extremely obliged, if you are aware of his having done so, to inform me of the nature of his reply in your valuable paper. It seems most ridiculous to me to insert these experiments in our English scientific text-books as true or legitimate experiments, when they have been successfully confuted by others, according to "Cosmoa." I may say they have led me astray considerably in my endeavours to obtain a correct knowledge of the nature of the solar spectrum, if what Helmholtz and Bernard state is true.

I am, &c.

G. Marlow.

MISCELLANEOUS.

On Spontaneous Generation.—The September and October number of the *Journal de l'Anatomie et de la Physiologie* contains the results of some experiments on spontaneous generation, by M. Al. Donné, which appear to the author favourable to this theory, although for a long time he has been one of its opponents. He has examined the result of exposing eggs to spontaneous decomposition during some weeks. He argued that, having thus an organised matter highly complex and naturally free from all floating atmospheric germs—and as this matter contained in itself a certain amount of pure air—it was in the best possible state to give rise, in its alteration, decomposition, and putrefaction, to infusoria, or animalcules, the ordinary result of the putrefaction of animal matter freely exposed to the air. With a substance naturally free from all foreign matter and protected from exterior contact, like the egg in the shell, the conditions of a crucial experience would be realised. Tried in this manner, the results were against the theory of spontaneous generation.

But the small quantity of air enclosed in the egg was not considered sufficient to determine the phenomena, and the experiments were tried again with certain modifications. The eggs were carefully washed, well dried, and then enclosed in a thick coating of cotton wool taken out of a stove at 150° C. A fine sharp rod, previously heated to redness, was then inserted obliquely through the cotton, and the tip of the egg was pierced with a hole. The eggs were then put in a safe place, and covered with a bell-glass. In a few weeks' time the surface of the contents of the egg was covered with velvety-looking mould, white, grey, yellow, or green. Under the microscope, this was seen to consist of organised filaments and beautiful globules of different sizes. There was, however, no trace of living animalcules. Supposing that the presence of water was needed, as the viscosity of the contents of the egg might hinder their development, a little boiling water was put into the egg covered with cotton. In two days, the substance was swarming with vibrios. The same experiments were then tried with hard-boiled eggs. The

result, therefore, appears to be, that we can produce at will vegetable or animal beings in pure organic matter, without the intervention of germs from without. Water is necessary to the development of infusoria; and air is indispensable to the development of living beings of either kingdom.

New Works and New Editions.—Amongst the forthcoming literary announcements likely to interest our readers, we find that Messrs. Churchill are about to publish "*Lectures on the Relation of Chemistry and Mechanics to Pathology and Therapeutics.*" By H. Bence Bence Jones, M.D., F.R.S. 8vo.—"*Urine, Urinary Deposits, and Calculi, and on the Treatment of Urinary Diseases.*" By Dr. Lionel S. Beale, F.R.S., Physician to King's College Hospital. With Plates. Third edition, very much enlarged. Crown 8vo.—"*The Microscope in its Application to Practical Medicine.*" By the same Author. With Engravings on Wood. Third edition. 8vo.—"*Chemistry, Inorganic and Organic; with Experiments.*" By Charles L. Bloxam, Professor of Practical Chemistry in King's College, London; Professor of Chemistry in the Department of Artillery Studies, Woolwich. With nearly 300 Wood Engravings. 8vo.—"*The Action of Medicines in the System.*" By Frederick W. Headland, M.D., F.R.C.P. Fourth edition. 8vo.—"*The Elements of Natural Philosophy.*" By Golding Bird, M.A., M.D., F.R.S., and Charles Brooke, M.A., M.B., F.R.S. With more than 600 Engravings on Wood. Sixth edition, thoroughly Revised. Fcap. 8vo.—"*The Pharmacopœias of the Principal Hospitals of London.*" Arranged in Groups for easy Reference and Comparison. By Peter Squire, Chemist in Ordinary to the Queen and the Prince of Wales; Member of the Pharmacopœia Committee of the Medical Council. Second edition. 18mo.—"*Handbook of Local Anæsthesia.*" By Benjamin W. Richardson, M.A., M.D., F.R.C.P. With Engravings. 8vo.—"*The First Step in Chemistry.*" By R. Galloway, F.C.S., Professor of Practical Chemistry in the Museum of Irish Industry. Fourth edition. Fcap. 8vo.—"*The Arrest and Prevention of Cholera:*" being a Guide to the Antiseptic Treatment, with New Observations on Causation. By Arthur Ernest Sansom, M.B. Fcap. 8vo.—"*The Induction Coil:*" being a Popular Explanation of the Electrical Principles on which it is Constructed. With a Series of Beautiful and Instructive Experiments. By Henry M. Noad, Ph.D., F.R.S., F.C.S., Lecturer on Chemistry at St. George's Hospital. With engravings. Fcap. 8vo.

Refracting Powers of Saline Solutions.—Physical processes may in certain cases be advantageously employed to determine the chemical constitution of bodies. Density, boiling point, dilatation by heat, and even the capillarity of liquids, have been suggested as giving useful results. One of the last numbers of Poggendorff's *Annalen* contains a memoir by M. E. Reichert, on the different refracting powers by fluids modified by their chemical composition. This memoir contains the results of experiments on solutions of common salt of different strengths. The proportions of salt shown by optical means and by ordinary analysis agree very closely. The first column of the following table gives the proportions obtained by analysis, and the second the results of the optical method:—

2·26	2·27
7·12	7·13
12·02	12·07
17·25	17·25
23·02	22·89

An equally satisfactory result was obtained with solutions of sugar; but with alcohol and acetic acid the differences in the refractive indices are only half as great, and the indications, consequently, are not so satisfactory.—*Les Mondes.*

The Hardness of Silver.—Goldsmiths often complain of the hardness of silver, which is sometimes very difficult to carve, and presents a dead grey cut. These properties are generally attributed to the presence of a foreign metal; but M. Mathey, assayer at Locle, has shown that in this silver there is neither tin, lead, nor any other injurious metal. He considers this property to be due solely to the high temperature at which silver is cast. By letting the crucible cool till a slight solid crust is formed on the surface of the fused metal, and casting at this moment, a soft silver with a brilliant cut is obtained. —*Dingler's Polytechn. Journal.*

On Candle-light Blue employed in the Dressing of Tissues.—According to M. Kletzinsky, there is employed, to a certain extent, in the dressing of light tissues, crapes, tulles, &c., a particular blue, the tint of which is in no way modified by artificial light. This blue is sulphindigotate of copper. It is prepared by dissolving indigo in Nordhausen sulphuric acid at 20°; after twenty-four hours, dilute with water, filter, saturate the liquid by carbonate of copper, and evaporate the filtered solution.—*Dingler's Polytechn. Journal.*

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. *Private* letters for the Editor must be so marked.

Vol. XIII. of the Chemical News, containing a copious Index, is now ready, price 11s. 6d., by post, 12s. 6d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I., II., and VII. are out of print. All the others are kept in stock. Vol. XIV. commenced on July 6, and will be complete in 26 numbers.

A. B. C.—The book has been sent by post.

Student.—You cannot have a better guide than Fresenius's "Qualitative Analysis," published by Churchill.

H. M.—Probably you will find bichloride of tin a useful solvent for iodine in your experiments.

Paraffin Wax.—A. B. is requested to send his address to the office, and the required information will be forwarded.

A Constant Reader.—You can probably dispose of amber dust at a photographic varnish-maker's. It is dissolved in chloroform, and used for coating glass negatives.

Mechanic.—Ordinary solder is made by melting together equal weights of lead and tin. If required more fusible, use three equivalents of tin and one of lead. This alloy melts at 367° F.

L——s.—Your article cannot appear. Indeed, no respectable journal would insert it. Apart from the exceeding bad taste of the attack, its publication would be libellous.

Photographic Printer.—Chloride of gold is always acid to test-paper. The pure compound met with in commerce is $AuCl_3,HCl+aq$. When this is heated, even in a water bath, to drive off the last equivalent of hydrochloric acid, some protochloride of gold is produced, which is not soluble.

Theta.—An ammoniacal solution of oxide of chromium is easily prepared by dissolving three grammes of potash chrome-alum in boiling water, then adding 14 c.c. of oil of vitriol and 90 c.c. of ammonia. The resulting liquid will be strongly alkaline and of a beautiful purple colour, and will keep unchanged in stoppered bottles.

John Mayer.—We are not aware when the next edition of Fownes will be issued, nor what views it will take as to the new notation. You may, however, be satisfied that it will be correct, and on a footing with the latest developments of the science.

Immo.—If the article is electro-plated, it will give the same reaction with the tests as if it were pure silver. File or scrape away some of the outer surface from a part where it will cause no disfigurement, and then test the metal beneath with nitrate of silver solution or a piece of moistened lunar caustic. If it be a base metal, it will be blackened.

Isinglass.—F. W.—We cannot understand what is meant by "isinglass" in the paragraph from the *Mechanics' Magazine* which you have sent. Can any of our readers favour us with a solution of the problem? The paragraph says:—"It is somewhat strange that in the course of the long series of explorations and experiments directed to the procuring of some indigenous substance with which to construct smelting furnaces, no effort is made to utilise isinglass. That substance is quite insensible to all influences of heat. Why may it not be ground and made into a plaster, and then worked into the smelting furnaces? The complaint is that nothing can be found to answer in place of the English firebricks, and they are enormously expensive. Perhaps our native isinglass would serve as a substitute."

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HODGKINSON, TONGE, and STEAD, Upper Thames St., E.C.
DANIEL JUDSON and SONS, Drysalters, Coleman St., E.C.
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On Indium, by M. Winckler,* *and MM.* Kachler *and* Schrötter.†

M. Weselky's method of separating indium from its solutions by means of hyposulphite of soda‡ is not, according to M. Winckler, advisable. By boiling a neutral solution of indium with hyposulphite, a small quantity only of the indium is precipitated, and that not as sulphide, but in the state of basic sulphate; from acid solutions, some sulphide of indium separates, while the greater part of the indium remains in solution. All the indium is only precipitated by hyposulphite of soda, when it is in the state of hydrate; but then it is as subsulphate, and not as sulphide, and this precipitation would have been more easily effected by using simply sulphate of soda.

M. Winckler considers it better, in extracting indium, to treat the roasted blende by hydrochloric acid, to precipitate by an excess of zinc the indium, copper, lead, cadmium, &c., and to separate these metals by sulphuretted hydrogen and carbonate of baryta.

MM. Kachler and Schrötter have ascertained the presence of indium in a blende at Schönfeld, near Schlaggenwalt. M. Schrötter modifies the method of extracting indium by treating the blende after roasting by sulphuric instead of hydrochloric acid, and precipitates the indium directly by zinc, fractioning the precipitates; the purification of indium is then easier in consequence of this division.

In its electric properties indium much resembles cadmium, but is more electro-negative.

The blue ray of indium has no corresponding black ray in the solar spectrum; it corresponds to number 2523 in M. Kirchhoff's scale; the violet ray of indium lies between rays G and H; it answers to number 3265·8. The spectrum of indium presents others besides these two rays, but they may possibly be owing to impurities.

Contributions to the History of Graphitic Acid,§ by M. Gottschalk.

To prepare graphitic acid, the author directs to add nitric acid in small portions to 1 part of purified graphite and 3 parts of chlorate of potash placed in a flask cooled with ice; then heat in a water-bath to about 70°. After decanting, purify the residue by extracting it by nitric acid of density 1·28, expelling any excess of the acid by gentle heat, washing the residue in alcohol, then in ether, and finally heating in a water-bath to expel the alcohol and ether; there thus remains a light pulverulent matter. The author considers that the substance described by Professor Brodie as graphitic acid, with the formula $C_{11}H_4O_5$, is not the last stage of the oxidation of graphite, but that there may be obtained, by prolonging the action of the oxidising mixture, a substance having the composition $C_{11}H_4O_6$, being a yellow, crystalline, homogeneous mass, formed of transparent flakes.

This substance is very hygroscopic, and colours in the light until it becomes nearly black. It reddens tincture of litmus when wet, and is slightly soluble in water. Its solution deposits amorphous yellow flakes under the influence of light or heat, or by the addition of a salt or a diluted acid.

This graphitic acid is also slightly soluble in alcohol, but not at all so in ether, wood spirit, essence of turpentine, benzol, chloroform, and sulphide of carbon. Heat decomposes it, giving water and carbonic acid. Alkaline solutions, lime, and baryta water colour it; when heated, the colour deepens till nearly black.

During the washing of graphitic acid treated by potash, the liquid is at first colourless, but soon becomes brown, and the product remaining on the filter greatly increases in volume. The brown alkaline filtered liquid, if boiled after having been neutralised by acetic acid, deposits brown flakes, and returns to its alkaline state, which proves the presence of an alkaline combination soluble in alkalies and decomposable by boiling.

The brown substance remaining in the filter, after treatment by an alkali, washed with water and dried at 100°, is difficult to pulverise, and becomes very electric by friction. It contains 11·2 to 12·3 per cent. of alkali.

This graphitic acid behaves in the same way in presence of ammonia; only, as ammonia volatilises readily, the precipitate inflates by boiling, and finally redissolves.

The author has verified the reactions of sulphide of ammonium and stannous chloride on graphitic acid, observed by M. Brodie.

Monohydrated sulphuric acid colours graphitic acid grey-green; by the addition of water it returns to yellow, and if boiled decomposes completely.

TECHNICAL CHEMISTRY.

The Manufacture and Properties of Aniline Colours, and the Bodies used in their Preparation, by MM.* Depoully *Brothers.*

(Continued from page 90.)

III. Aniline.—Nitrobenzol submitted to the action of reducing agents changes into aniline according to the equation—$C_{12}H_5NO_4 + 6H = C_{12}H_7N + 4HO$.

Many trials have been made to effect this change on a large scale; but M. Béchamp's process—that is, the action of iron and acetic acid on nitrobenzol, is generally decided to be the best.

M. Béchamp introduces into a retort 50 gr. of commercial nitrobenzol, the same quantity of acetic acid, and 100 gr. of iron filings. The reaction manifests itself in a strong effervescence; when that ceases he cohobates and then distils to dryness; the aniline passes with the water.

These proportions have been modified in practice; there is no fixed rule, each manufacturer using his own proportions, as well as his particular apparatus and mode of working. Further on we will refer to the necessary proportions, and will first describe two processes as examples, one having its origin in France, the other in England. In the first the reaction is effected without the help of artificial heat; in the second by the aid of steam.

First Process.—The proportions employed are:—100 parts of nitrobenzol, 60 to 65 of commercial acetic acid, and 150 of medium-sized pounded iron turnings.

The iron and nitrobenzol being introduced into a cast-iron boiler, the acetic acid is added, either all at once or in two portions at an interval of twelve hours. About

* *Journal für praktische Chemie*, vol. xciv., p. 414.
† *Ibid.*, xcv., 441.
‡ See *Bulletin de la Société Chimique de Paris*, iv., 194.
§ *Journal für praktische Chemie*, xcv., 321.

* Memoir presented to the *Société Industrielle de Mulhouse* at the meeting of May 31, 1865.

an hour after contact a violent reaction takes place, with a strong effervescence and the production of a considerable amount of heat; then the reaction ceases, and the mass must be stirred with a rake; the action recommences, and the stirring must be continued whilst any reaction takes place. The operation requires thirty-six or forty-eight hours.

The boiler should be closed by a lid which communicates with a worm or ascending refrigerator, so as to condense the vapours produced, and bring them back to the boiler. When this is not attended to, a notable loss occurs.

The mixture is found to be transformed into a thick homogeneous paste, containing excess of iron; all the nitrobenzol is changed into aniline, mixed with acetic acid and oxide of iron. This paste is then placed in semicylindrical boats of thin sheet-iron, and these are introduced into cylindrical horizontal retorts, slightly flattened like gas retorts, but of cast iron and of large dimensions. By the action of heat the aniline is distilled, mixed with water, and is condensed in a cooled worm.

The furnace should be so constructed that the upper part of the retort is not in contact with the flame, for otherwise a portion of the vapour of aniline becomes decomposed. As the vapour of aniline is easily condensible, the escape pipe should be placed as low as possible, and have no ascending inclination.

The use of boats offers great advantages in point of the rapidity with which the cylinders may be discharged and recharged whilst they are hot. When a little common salt and soda are added to the mixture of aniline and water resulting from this distillation, it forms two layers; the aniline, occupying the superior part, is decanted and rectified by distillation.

Second Process.—The proportions are:—100 nitrobenzol, 8 to 10 acetic acid, 200 iron. The operation is conducted in an iron cylinder placed vertically. In the middle of this apparatus is a shaft, made hollow to contain steam, and furnished with arms to agitate the mixture. This shaft communicates by driving wheels with the motive power. A pipe placed in the upper part of the cylinder conducts the vapours to a worm.

The iron and the acetic acid being introduced into the apparatus, add about 20 kilogrammes of nitrobenzol. A violent reaction takes place; when that ceases, set the shaft in motion; let the steam enter, and at the same time introduce, in a continuous stream, the remainder of the nitrobenzol which is in the upper reservoir. The aniline distils with the water condensed from the steam.

The great advantage of this process is the small quantity of acetic acid employed; but we think that when once the transformation of the nitrobenzol into aniline is effected it is better to stop the operation, remove the paste and introduce it into the retorts, and conclude the operation as in the previous process.

More aniline ought to be obtained by this process, but its solubility in water causes loss, and the distillation cannot be so complete as over an open fire; we lose the high anilines, which are the most useful.

In the English process we see that, provided it takes place in presence of iron and water, a given quantity of acetic acid will transform an indefinite amount of nitrobenzol. Experience enlightens us regarding the different phases of the reaction.

Thus, the acetic acid attacks the iron and forms ferrous acetate and hydrogen; the nascent hydrogen changes the nitrobenzol into aniline and water.

The ferrous acetate, in the presence of water and of nitrobenzol, becomes ferric acetate and ferric oxide, and reduces the nitrobenzol to the state of aniline.

The aniline formed decomposes the ferrous and ferric acetate, and precipitates them as oxides and hydrates; the ferrous oxide attains the ferric state at the expense of the nitrobenzol; and, as the acetate of aniline attacks the iron like acetic acid, the reaction continues indefinitely whilst there remain water, iron, and nitrobenzol; the definite products being aniline and ferric oxide.

Commercial anilines are always combinations of various proportions of aniline and toluidine; in consequence of the first bodies employed to make the nitrobenzol never being either pure benzol or pure toluol, aniline distilling at 182° and toluidine distilling at 198° cannot be obtained. Moreover, they contain various secondary products, proceeding from the impurity of the hydrocarbons employed, the manufacture of the nitrobenzol or that of the aniline.

Among these secondary products oftenest met with in commercial anilines are:—The alkaloids distilling above 200° and proceeding from the benzols containing hydrocarbons of a higher equivalent than toluol. Benzol, resulting from incompletely made nitrobenzol. Phenylene and toluene diamines, resulting from the reduction of binitrated bodies contained in the nitrobenzol. The nitrobenzol incompletely attacked in the manufacture of the aniline. Acetic acid and its derivatives, acetanilide and acetoluide. Considerable quantities of these bodies are often found in anilines, but to a less extent since the diminution of the proportions of acetic acid used in the manufacture of aniline. Acetone, which is especially produced in manufactories where lime is added at the moment of distillation in metal retorts.

A good part of these impurities is separable by rectification, but much always remains.

In testing commercial anilines, density must be taken into account. The density of aniline is 1028, that of toluidine is from 1001 to 1002. An aniline of density below 1000 contains acetone or benzol. An aniline of above 1030 contains nitrobenzol or other heavy bodies.

Another essential experiment is that of dissolving aniline in at least half its weight of sulphuric acid diluted with three times its weight of water. It forms a thick paste of sulphate of aniline; and on diluting and dissolving the salt, if there are any tarry bodies, nitrobenzol, &c., they will float on the surface of the liquid.

In submitting aniline to fractional distillation, reject all below 180° and above 200°.

On submitting the same aniline to distillation in the presence of a small quantity of caustic soda, then distilling anew, the product should pass at the same degrees as in the distillation of the aniline itself. If, as often happens, there is a great difference, it is owing to the presence in the aniline of acetic acid and its derivatives.

Many errors are attributable to the presence of these various impurities in anilines. A manufacturer often thinks he possesses a high aniline, when in reality it is a low impure one.

An idea may be gained by fractional distillation of the composition of commercial aniline as to the quantities of aniline and toluidine. We can thus nearly ascertain its composition, but not the mode of separating aniline and toluidine.

When a mixture of these two alkaloids is distilled, it passes continuously from 182°, the boiling point of aniline, to 198°, the boiling point of toluidine. However,

it is noticeable that the thermometer remains some time stationary, first between 187° and 188°, and then between 192° and 193°.

The liquids which distil at these points are definite mixtures, the first containing 2 parts of aniline and 1 of toluidine, the second 1 part of aniline and 2 of toluidine. The first has a density of 1018 and the second 1010. These densities are just the mean densities of mixtures of the two alkaloids in the proportions of 2 to 1 and 1 to 2.

The conclusion to be drawn from these observations is, that it would be far better to manufacture aniline and toluidine each separately and as pure as possible, in the manner already explained in the two preceding chapters on this subject, and this should be the aim of manufacturers of commercial aniline.

PHARMACY, TOXICOLOGY, &c.

Notes on Plasma, by Mr.* G. F. Schacht.

Early in the year 1858 a paper of mine was read before the Pharmaceutical Society, entitled "*Glycerine, a Proposed Substitute for Oils and Fats in Ointments.*"

The discussion which followed the reading of this paper (supposing the report in the *Journal* to have been correct) appeared to me at the time, as it appears to me now, by no means characterised by judgment or candour. It seemed to be assumed that the proposed substitute, "plasma," was identical with a certain something else that had been tried and found wanting, and that therefore there was little hope for plasma. The two things, however, were not alike. Unfortunately, I was unable to be present on the occasion, and, as no defence for the proposition was volunteered by any other person, a verdict, on the whole adverse, was delivered by the learned critics. Notwithstanding this damaging circumstance, certain individuals, both in my own neighbourhood and in other localities, were differently impressed, and, having given the preparation something of a trial, arrived at the conclusion to continue its use. And so, after eight years' experience, I am not a little pleased to find plasma not only talked about, written about, and prescribed, but also that a proposition has been made by no less an authority than Dr. Redwood to introduce it into the next Pharmacopœia.

From the date of my paper (February, 1858) to the present moment I have made no further public allusion to the article; I may, perhaps, then be excused if I now once more obtrude it upon my fellow-pharmaceutists.

It is, perhaps, undesirable that I should follow every one who has expressed himself upon the matter; in referring, however, to the opinions and observations of a few, I trust to be understood to imply no disrespect for the labours of the rest.

I may observe, as a general remark, that those who have written upon the matter express opinions favourable to the preparation; the objections to it have usually been uttered in conversations and discussions upon these more deliberately expressed opinions. The list of tangible objections, however, is not large; it amounts to no more than two. These are serious objections, I admit, if they really exist, but they are not numerous.

The first is, that the preparation becomes softer by exposure to the moisture of the air; and the second, that it is liable to become mouldy by keeping.

With regard to the first, I think we must admit that it is a difficulty. I pointed it out in my original paper, and I do not think there is any prospect of our being able altogether to obviate it. We must accept it as a property of all preparations of glycerine, and avoid exposure to moisture as much as possible. But I have not found this property of much practical inconvenience. I have kept plasma in a common covered pot for a long time without apparent change. Here is a sample kept in this way since December, 1865, and it is still of very good consistence. But if the article be really useful, there would be no more difficulty in preserving it in well-closed vessels than many others about which we have to be specially careful.

The second alleged objection to plasma is, that it becomes mouldy by keeping. This statement is backed by the authority of names that command respect. Mr. Dean and Mr. Squire have both recorded this fact against plasma, and it is difficult to discredit anything advanced by observers of so large experience and of such well-known carefulness. But without intending any contradiction of the observations of others, I am bound to assert that I never saw a particle of mould upon plasma, and that since 1858 I have never been more than a few days at a time without plasma in stock. It is possible the mould to which these gentlemen refer may have appeared upon some of the compound plasmas. I admit I have not kept many of these for any length of time, but such as I have kept—Plasma linci and Plasma petrolei—have remained as free from mould as simple plasma itself. I do not therefore feel disposed, as yet, to admit "a disposition to become mouldy by keeping" as a proved fact against plasma; but, on the other hand, am bold to assert that it has but the one weak point already admitted.

Though I have prepared plasma in batches varying from one ounce to twenty pounds, and have for experimental purposes occasionally modified my formula, I have found no advantage to result from any change, either in the proportions of the ingredients or in the selection of any particular starch granule. Some experimentalists have supposed considerable differences in the results to have attended the employment of different feculas. My own experience goes rather to constrain me to attribute all variations of result to slightly altered manipulation. For instance, if, after heating the mixed ingredients to the required temperature and for the required time, the vessel be removed from the fire and its contents allowed to cool without further stirring, they will become gelatinous and toughly elastic, a consistence very inconvenient for the required purpose, but by a little judicious stirring during the process of cooling this may be entirely obviated, and an excellent ointment-like consistence obtained. Again, I have observed the translucency of the result to depend a good deal upon the time the mixture is exposed to heat, and the amount of stirring during the last part of the process. I find arrowroot, tous-les-mois, and potato starch will all give equally good results under exactly similar circumstances; and, on the other hand, they all, under slightly modified circumstances, will yield inferior results.

My experience, therefore, leads me to suggest but little change in my original instructions, which were as simple as could well be—viz.:—"Take of starch-powder 70 grs., glycerine 1 fl. oz.; mix the ingredients cold, and heat to 240°, constantly stirring." All I would add to that is, if the batch be large, say 10 lb. or 20 lb., it is better to escape the dreary task of constantly stirring so large a mass, whilst it is being gradually heated to 240° (which must be done if the starch be added). This

* Read before the Pharmaceutical Conference, Nottingham meeting.

can be accomplished by mixing the starch with about one-twelfth of the glycerine, placing the remainder on the fire, and, when this has become heated to 260° (which will involve no special attention), mixing all together and stirring till complete. I venture then to repeat my opinion that plasma, carefully made, is a very elegant and useful material, possessing features of undoubted advantage over the fats commonly employed for ointments, and is not liable to any serious inconveniences.

I wish now more particularly to refer to some of Dr. Redwood's remarks contained in his paper, "*On the Construction of a Pharmacopœia*" (April 5, 1865), and more especially to the nomenclature by which he proposes to designate this solid preparation of mine and certain other classes of fluid compounds of glycerine. He introduces the matter by a kindly and favourable mention of plasma. He says (vol. vi., 2nd series, p. 572):—

"In external applications, also, some improvement has been made. The old form of ointment has often been referred to as one calling for improvement, for what can be more offensive than a rancid unguent smeared over the skin? The so-called 'plasma,' which was introduced by Mr. Schaeht, of Clifton, in 1858, is certainly a great improvement in elegance and the absence of repulsiveness upon the forms previously used for similar purposes. This plasma, which is a solution of starch in glycerine, has now been in use for several years, and there appears to be but one objection to it, which is that, if exposed to the air, it absorbs moisture, and is then liable to become mouldy. But it has several recommendations, and it will probably come into more general use as it becomes more extensively known."

He then alludes to a class of preparations in which glycerine acts as a useful solvent, and in which the resulting compounds still retain the fluid form of the solvent. After commending these also as a useful series of applications, he proceeds to criticise the names by which they have hitherto been called. He says:—

"If glycerine is to be thus used, it is desirable that we should have some name that could be conveniently applied in pharmacy as a generic name for solutions where it is employed as the solvent. Some names have been already proposed, but none of them appear to me unobjectionable. Solutions in glycerine have sometimes been called glycerotes, but this name is suggestive of a property the reverse of that which glycerine imparts. Glyceroleum cannot, therefore, be considered a suitable generic name for a class of preparations distinguished from olea and unguenta by the possession of entirely different characters. Then we cannot call them glycerides or glycerates, because these names are already appropriated as chemical names, having different significations from those here intended. I would suggest that the name glycemate might be suitably used for these preparations. This name has not yet been appropriated that I am aware of, and it seems to fulfil what is required. The word glycemate would be glycematum in Latin, and this would apply to solutions of substances such as I have named in glycerine. The solution of starch in glycerine, Mr. Schacht's Plasma, would be Glycematum Amyli, glycemate of starch. Under this name it would be included among other solutions in glycerine; but as this glycemate of starch may itself become the basis of a class of external applications, while others of the glycemates are applicable for different purposes, it would be desirable to have a name that could be used as a generic name for preparations of glycemate of starch with more active ingredients. Thus the glycemate of starch forms a good vehicle for the application of aconitia, atropia, &c., and what name should be applied to such? I would suggest that the name Glycematum Amyli should be abbreviated into Glycemylum, which would be a synonym for glycemate of starch, and a generic name for preparations consisting of what is now called plasma, with the addition of other substances.

We should thus have—

Glycematum Amyli, Glycemate of Starch. Synonyms: *Glycemylum*, glycemyle, Plasma. Solution of starch in glycerine.

Glycematum, Aloës, Glycemate of Aloes. Synonym: Glycerole of Aloes. Solution of Aloes in glycerine.

Glycematum Boracis, Glycemate of Borax. Solution of borax in glycerine.

Glycematum Carbolicum, Carbolic glycemate. Solution of carbolic acid in glycerine.

Glycematum Gallicum, Gallic glycemate. Solution of gallic acid in glycerine.

Glycematum Tannicum, Tannic glycemate. Solution of tannic acid in glycerine.

And then we might have—

Glycemylum, Glycemyle. Synonym: Plasma. Solution of starch in glycerine.

Glycemylum Aconitiæ, Glycemyle of Aconitia. Solution of aconitia in glycemyle.

Glycemylum Atropiæ, Glycemyle of Atropia. Solution of Atropia in glycemyle, &c.

Now, I think the author's strictures upon the names glycerole, glyceride, and glycerate are perfectly fair, and I agree with him in thinking they ought not to be used, but I cannot see that the new ones he suggests are one whit better. In the first place, the words glycematum and glycemylum are very much like each other, the difference not only being slight, but being also one that would by no means easily fix itself in the memory of the prescriber and dispenser. Here are two distinct forms of remedy as different in physical features as an "extract" differs from a "liquor" or an "aqua." Why, then, call them by names which sound and look so much alike? I admit that glycemylum suggests itself as a compound word of glycerinum and amylum, but then that does not necessarily imply that glycemylum is solid, for unless heated the ingredients would remain fluid. But I do not at all see the etymological appropriateness of glycematum. A glycemate might certainly be a correct name for a compound of glycerine acid (did such a thing exist) and a base; but, as this is not intended, I can only suppose the word to be also a compound of glycerinum and pomatum. But that would rather suggest a solid, inasmuch as pomatums usually are solid. But Dr. Redwood applied this term to the fluid class of preparations.

I cannot help thinking that the Doctor has passed over the most simple, the most natural, and the most correct name for these fluid glycerines. When we dissolve small portions of foreign substances in water, we call the resulting fluids waters, aquæ. A little oil of cinnamon dissolved in water constitutes cinnamon water, aqua cinnamomi. A little lime dissolved in water we call lime water, aqua calcis, &c. We do not find it necessary to increase the mystery of the matter by talking of an "aquate of lime," "aquatum calcis," "aquatum cinnamomi;" why not, therefore, call a solution of aloes in glycerine "aloes glycerine,"—Glycerinum Aloës—or a solution of tannin in glycerine Glycerinum Tannicum? Such a nomenclature would be too simple and obvious for confusion, and the whole series of medi-

eated glycerines would lie together with the simple solvent at their head.

And with regard to the solid series—plasma and its compounds—I cannot help thinking they had better continue to be called by the name under which they were introduced. As godfather to the interesting stranger, I may perhaps be somewhat partial; but I think the name both euphonious and descriptive: it implies something to be spread; it is not more arbitrary than others we employ with great convenience, such as "tinctura" and "emplastrum," and it serves to discriminate peremptorily between the solid and the fluid forms of the glycerine applications.

If, then, these preparations are honoured with places in the new Pharmacopœia, I hope they will appear under the easily-recognised names of "glycerina" and "plasmæ."

The Exhibition of the Pharmaceutical Conference, Nottingham.

Press of more important matter has prevented us from noticing this Exhibition before, but we are unwilling to omit all mention of it, as there were many points connected with it which well deserve notice. It was remarkable not only for the variety of the objects exhibited, but likewise for the scientific interest of many of them. Many of the contributions were from considerable distances, and to their American brethren the members of the British Pharmaceutical Conference are under great obligations for a very interesting collection forwarded from the other side of the Atlantic. Many branches of Materia Medica were very fully represented, and in going round the room we were struck with the names of many persons whose names, both as scientific chemists and practical pharmaceutists, are familiar to the readers of the Chemical News.

To give a notice of everything present would fill many more pages than can be spared for the purpose; we must be satisfied with mentioning a few of the more prominent things which attracted our attention, confining ourselves chiefly to those interesting from their novelty or scientific characters.

Amongst the apparatus and novel processes we noticed an ingenious arrangement for the preservation of liquids liable to be injured by exposure to the air, by Mr. Bourne. It consists of a thin membrane, which being attached to the side of the cask or other vessel, divides the interior into two separate chambers of varying capacity. Being formed in size and shape to correspond with one half of the vessel, it lines, or fits tightly to, either the upper or lower portion, according as the vessel is full or empty. When full, the diaphragm, floating on the surface of the fluid, precludes evaporation, and shields it from contact with the air which is freely admitted above. Descending as the fluid is withdrawn, it protects the remainder to the last, and preserves the empty vessel from becoming foul or musty, so that a simple rinsing with warm water is all that is necessary to fit it for fresh use.

Mr. Casella exhibited some of the mural standards of measure, having metrical and English systems side by side.

Messrs. Cliff and Co. exhibited many pieces of apparatus for which their Lambeth Potteries are so justly famous.

Messrs. Johnson and Sons exhibited a series of platinum crucibles, platinum spatula for pocket, platinum-wire net for straining and electroplating operations; platinised copper bowl for counter or laboratory use small and cheap platinum spoons for blowpipe experiments, especially useful for students; various preparations of platinum; silver crucibles, basins, and funnels. We would draw attention especially to the platinised copper bowl as a valuable addition to the dispensing counter or laboratory. Messrs. Johnson and Son contemplate introducing to pharmaceutists dispensing fiscale-pans, made on the same principle as the bowl, which, for their elegance, cleanliness, and convenience, we expect will be generally adopted by dispensers.

Messrs. Krohne and Sesemann exhibited a large series of Dr. Richardson's anæsthetic apparatus, one with reservoir and double tube for major operations, a spray producer, and inhalers for aqueous or other vapours, fitted with a variety of heating contrivances.

Messrs. S. Maw and Sons exhibited a very large collection of medical and surgical instruments and appliances.

Messrs. Murray and Heath sent pocket microscopes, demonstrating class microscopes, and a portable polariscope.

M. L. André Pontier, Boulevart du Temple, Paris, exhibited Kessler's evaporating and distillatory apparatus, called by the inventor by the general name of "erorator." This consists of a series of superposed vessels, each connected with a refrigerator common to all, and so arranged as to economise the whole of the heat employed, and insure the perfect condensation of the vapour raised, whether of water or alcohol, plain or medicated. It is further adapted for the inspissation of all kinds of extracts at a low temperature, for the crystallisation of salts at fixed temperatures, and, when made of platinum, for the distillation of sulphuric acid. The distillatory apparatus for the evaporation or economical concentration of liquids is so constructed that vapour formed during the evaporation of a liquid can be collected, and hence distillation may be effected, as it is but a condensation of a vapour. From this it will be understood that whenever it is desired to distil or evaporate a liquid in order to concentrate it, the erorator may be used with most advantage, as it serves the double purpose. Before describing in detail the component parts of the erorator, it may be considered as a pan with a lid. Every one has noticed that when a pan containing water has a lid larger than itself, and is placed on the fire, little drops come together at the lower part of the lid, and fall spontaneously around and outside the pan on the stove-plate. This was the true and original idea from which the present perfect erorator was formed. These drops come from vapour which is condensed at the lower portion of the lid; these are collected in the erorator as distilled water, by means of a channel placed under the sides of the lid. Lastly, to increase the condensation of vapour in proportion as it is formed, a current of cold water is made to play on the lid.

From Mr. Robbins we noticed some of his registered inhalers in porcelain, and anæsthetic ether specially prepared.

Mr. Squire sent a set of imperial weights with metrical equivalents engraved thereon.

Mr. E. C. C. Stanford illustrated his patent process of treating seaweed by destructive distillation. The specimens illustrated the method of distilling seaweed, and substituting for a fused ash, called kelp, a highly porous charcoal, the former being a vitreous mass, prepared in contact with air at a high temperature, from which most of the iodine has been dissipated; the latter carbonised at a low red-heat, in closed iron retorts, retains the

whole of the iodine existing in the seaweed. This process is carried out by the British Seaweed Company (Limited), in works in the outer Hebrides; one in the Island of Tyree, and another in the Island of N. Uist. The charcoal prepared here is shipped to other works on the Bowling Canal, near Glasgow, and there lixiviated. The specimens illustrate the original sea tangle, which is thrown up in the winter in large stems, about 8 feet long and 1½ inch in diameter; these, when dried, shrink to about ¼ inch diameter, and closely resemble horn; after carbonisation, these expand to about ¾ inch diameter, forming a highly porous charcoal, containing about 40 per cent. salts. Through the lixiviation of this charcoal, fine colourless specimens of salts are obtained. Those exhibited are all commercial specimens, and consist of muriate of potash, 97 per cent.; sulphate of potash salt, containing 17 per cent. alkali; iodine, bromine, iodide of potassium, and bromide of potassium. The commercial specimens of iodine and bromine are very pure; the latter, the manufacture of which, from this source, was introduced into this country by Mr. Stanford, is now made on a large scale in Scotland. The muriate is obtained unusually pure by this process, 80 per cent. being the usual standard. The salt also contains a large proportion of alkali, 8 per cent. being not uncommon. The products of distillation exhibited are—muriate and sulphate of ammonia, tar, oils, and pitch from the tar, and acetone naphtha. Gas is also produced and used to light the factories in the outer Hebrides. The charcoal, from its high porosity, is introduced as a deodoriser; its chemical composition resembles that of animal charcoal rather than that of vegetable charcoal, and the products of distillation are closely analogous to those of bone. This is especially interesting, as tangle, being a pure alga, is close to the border line separating the animal from the vegetable kingdom. For the filtration of water and disinfection of sewage, this charcoal affords a convenient substitute for animal charcoal at one-fourth the price.

Mr. F. Sutton, Norwich, who has made volumetric analysis his speciality, and has written perhaps the best book on the subject, exhibited twelve Mohr's burettes, graduated in cubic centimetres and decems, with Erdmann's floats; two revolving stands of new and convenient shape, to carry six burettes each; stoppered graduated flasks and test mixers; standard volumetric solutions of the British Pharmacopœia; new blowing burette for solutions which are affected by the india-rubber in the usual Mohr's burette, such as permanganate of potash, &c. The graduation of these instruments is guaranteed to be very correct.

Dr. J. Attfield, the hon. secretary, exhibited a set of metric decimal weights in brass, as used by chemists and druggists in France and other countries. Ditto in iron, as used by grocers and others. Ditto in brass, aluminium, and platinum, as used by analytical chemists in all civilised countries. A specimen of the wooden metre used by drapers. A jointed metre, used by carpenters. A decametre tape. A set of pewter measures, from double litre to centilitre. Glass metric decimal measures in various forms. A set of dry measures, from decalitre to decilitre, as used by seedsmen, &c. A set of the decimal coins used in France, Italy, and elsewhere, their weights, diameters, &c., being on the metric system. An American coin, 5 cents in value, 5 grammes in weight, and 2 centimetres in diameter. In a paper read before the Conference, "On Weights, Measures, Coins, and Numbers," the exhibitor stated that his object in showing the articles enumerated above was to aid in familiarising chemists and druggists with a system of weights and measures already noticed in the British Pharmacopœia, and destined, sooner or later, to be universally adopted.

Mr. James Yates, F.R.S., exhibited diagrams and models intended to aid in teaching the metric decimal system of weights and measures in schools.

Messrs. Heaton and Sons showed specimens of decimal coins in accordance with the metric system, now being manufactured for the Italian Government.

Amongst medicines, drugs, and chemicals, several were from the United States. Thus, Prof. E. Parrish, of Philadelphia, exhibited one half gallon metallic pharmaceutical still; a patent gas furnace for pharmaceutical purposes; sundry interesting pharmaceutical preparations and specimens of dispensing bottles and boxes, with illustrations of the mode in which medicines are sent out by pharmaceutists in America;

Messrs. Squire and Co., of Cincinnati, a variety of pharmaceutical preparations;

Mr. Frederick Stearns, Detroit, a variety of pharmaceutical preparations;

William R. Warner and Co., Philadelphia, a handsome case containing ninety varieties of pills, prepared according to the Pharmacopœia of the United States and other recognised formulæ. The peculiarity which these pills present is, that they are all sugar-coated. This plan shows some important advantages, viz., an attractive taste and clean exterior; but it is chiefly to be recommended as an effective mode for the preservation of the pill from the variable effects of atmospheric change.

Mr. Bakes, of Philadelphia, sent a volume of American labels, comprising dispensing and other trade labels, together with a great variety used for pharmaceutical preparations.

From Beaufoy and Company, of Lambeth, we noticed *acetate of lime*; pure *acetate of soda*, from which their acetic acid is made; *acetic acid*, British Pharmacopœia; *glacial acetic acid*; *malt*, from which their vinegar is made; *pale vinegar* of normal colour, and *coloured vinegar*, as the public in general will have it.

Mr. Davis, of Harrowgate, sent a case containing tubes, exhibiting at a glance the relative *saline residues* of a pint of each of the Harrogate waters. This case has subsequently been presented to the Museum at Bloomsbury Square.

(To be continued.)

On the Estimation of Morphia in Opium: Improvements on M. Guillermond's Process, by M. Roussille.

M. Guillermond's process, which consists in macerating the opium in cold alcohol of 72 per cent., is very accurate, but it possesses the inconvenience of being long. I propose to introduce some modifications. 15 grammes of opium are treated with 25 grammes of boiling water till complete disaggregation; then add 60 grammes of boiling alcohol at 40°; digest for an hour, and filter through linen; then treat the residue again with 10 grammes of water and 60 grammes of alcohol as before. Now extract the residue with 50 grammes of boiling absolute alcohol. All the liquids collected together and cooled are to be carefully filtered, evaporated to one-third, and filtered again after cooling. Then precipitate the morphia with 10 grammes of ammonia, and evaporate over sulphuric acid. At the end of three days collect the deposited crystals, and wash them with ether and with water.

Six successive trials have given the same results as by Guillermond's process, which takes more than five days, whilst this only requires three.

PHYSICAL SCIENCE.

On the Spectrum of Aqueous Vapour, by M. J. Janssen.

I have the honour of acquainting the Academy with the discovery of a new optical property of steam, which, it appears, must lead to important results in celestial physics and meteorology. The optical study of this vapour has just brought to light the fact that it possesses a power of elective absorption on light, or, in other words, that it gives rise to dark lines and bands in the spectrum of a luminous beam which has traversed a sufficient thickness. But before entering into a detail of experiments, I shall ask permission to recall briefly the researches on spectrum analysis which first led me to this inquiry.

It is known that the illustrious Brewster discovered, about 1833, what are called the atmospheric bands of the solar spectrum. Brewster perceived that when the sun was near the horizon its spectrum was enriched with new dark lines. This fact, compared with others of the same kind—viz., the action of nitrous gas—led the English physicist to the just idea that our atmosphere might act in the same manner, and thus become the cause of the dark lines observed when the sun was near the horizon; he even thought that all the solar lines might be accounted for in this way. Unfortunately this fine conception could not be demonstrated in a complete manner. Indeed, these dark bands generally faded away as the sun rose, and no perceptible traces of them remained as it passed the meridian.

Later, a direct experiment, in which Drs. Brewster and Gladstone tried to reproduce the gaps in the solar spectrum by examining an artificial light at a great distance, did not give a satisfactory result. The question of the origin of the dark lines and bands was not therefore determined, but some important ideas and facts have been gained, which may serve as a groundwork for further research.

A short time after the publication of the large memoir of Drs. Brewster and Gladstone, which sums up the labours of these gentlemen on this question, M. Kirchhoff made known his studies on the solar spectrum. The result of these is well known; the origin of the lines was carried back to an atmosphere surrounding the sun, and on studying them, the chemical composition of this atmosphere was disclosed. Between the ideas of Dr. Brewster, seeking to explain the solar spectrum by the action of the atmosphere of the earth, and those of M. Kirchhoff, assigning its origin in a solar atmosphere, there was room for a less exclusive and more complete theory, which would include both causes, and point out the double origin of the lines which Wollaston and Fraünhofer discovered in the prismatic image of the sun. The solar origin of a portion of the lines being pointed out, the action of our atmosphere remained to be proved. This is the object of the studies which I have undertaken since 1862.

By some new optical arrangements I first showed that the bands of Dr. Brewster were formed of a multitude of fine lines, comparable, strictly speaking, to those of the sun.

Further, the study of these lines has proved to me that they are permanent in the spectrum, although incessantly variable in their intensity, according to the height of the sun—that is to say, according to the density of the atmosphere traversed by the rays of that luminary. These results proved that our atmosphere exercised some action. To corroborate them, I studied the spectrum on a high mountain, the Faulhorn (September, 1864), and there I saw the rays of terrestrial origin weaken in proportion as I went higher, and as the solar rays traversed a lesser density of terrestrial atmosphere.

Subsequently, in an experiment made on the Lake of Geneva (October, 1864), I was able to reproduce the same lines artificially. The flame of a large pile of fire-wood, which, when close, gave no line, except that of sodium, at 21 kilometres' distance showed the atmospheric lines of the solar spectrum. This harmony of proofs showed, then, the evident action of our atmosphere, and the double origin of the lines of the solar spectrum. I may add that the atmosphere, notwithstanding its small height and the low temperature of the gases which form it, acts on the light as powerfully as the atmosphere of the sun, although in a very different manner. In the red, orange, and yellow of the spectrum, a system of lines ten times more numerous than the solar lines of these regions is produced by the atmosphere of the earth. On the contrary, it is the lines of solar origin which prevail in the green, blue, and violet. Thus, these two atmospheres, so different in their actual temperatures, are not less distinguished by their actions on the light. They divide the spectrum in a manner; the atmosphere of the earth, which is of low temperature, acts specifically on the rays having long wave length; the solar atmosphere, which is of high temperature, exerts its elective action on the rays having short wave length.

Let us now inquire briefly to what elements of the atmosphere this action must be attributed.

Now, the attentive study of the solar spectrum led me, two years ago, to assign a very important place in the production of the telluric lines to the aqueous vapour dissolved in our atmosphere. Indeed, comparisons carried out for a long time at different seasons of the year, showed very clearly that, for the same heights of the sun, certain lines of the spectrum of this luminary were the more definite as the dew point rose higher. The observations made on the Faulhorn again confirmed these indications. I was able, during some very dry days, to see the lines in question fade entirely from the spectrum. Again, in the experiment made on the Lake of Geneva, I was led to choose the lake from the consideration that the luminous beam, in glancing on the surface of the water, must traverse some strata of damper air, which added to the chance of success, and the result confirmed this foresight.

There then remained little doubt of the action of aqueous vapour. However, it was necessary, in proportion to the importance of the result, to submit this theory to a direct proof by studying the changes which a ray of light would experience in passing through a tube, of sufficient length, containing nothing but steam. Unfortunately, this experiment presented great practical difficulties. Our atmosphere contains so much aqueous vapour that, to realise artificially the effects which it produces on the solar light, it was necessary to use apparatus of such increased dimensions that the results were difficult to realise.

A first attempt took place at the central manufactory of lighthouses. M. Allard, head engineer in this establishment, wished to assist me, but the tube which we set up was not long enough to show the phenomenon sufficiently; but I have since been more fortunate. M. Goschler, superintendent of the studies at the Central School of Architecture, referred me to the superintendent of the Parisian Gas Company, and to the head engi-

neer. These gentlemen put at my disposal the large resources which this establishment possessed.

A tube of iron of 37 metres was set up; it was put into a wooden case of the same length containing some very dry sawdust—an arrangement which prevented any sensible loss of heat. The steam was furnished by an engine of six-horse power, and the light by sixteen jets of gas adjusted in a line with the axis of the tube.

This light, which it is well known gives a continuous spectrum, allows the production of the faintest dark bands to be perceived.

The experiments are being carried on at this time, and I now acquaint the Academy with only the first results, which, however, confirm, in the most complete manner, what the study of the solar spectrum before indicated to me.

In an experiment (August 3, 1866) where the tube, quite free from air, was full of steam at a pressure of seven atmospheres, the spectrum appeared with five dark bands, two of which, well defined, were in the portion from D to A (Fraunhofer) calling to mind the solar spectrum seen in the same instrument towards the setting of the sun.

From the first comparisons made between the spectrum of steam and that of solar light, Fraunhofer's group A, B (in greater or less part), the group C, and two groups between C and D, are owing to the action of the aqueous vapour of the atmosphere.

Moreover, this experiment has given another interesting result. The spectrum of the transmitted light appeared very dark in the most refrangible part, whilst it was brilliant in the regions of the red and yellow. Thus, although aqueous vapour absorbs certain red and yellow rays powerfully, it is mostly very transparent in these rays, while it acts in a general manner on those which are most refrangible. It follows from this that steam would be of an orange-red colour by transmission, and redder in proportion as it acts under a greater density.

This result will require to be verified and established with the greatest care, and I do not present it here without reservation. If it be definitively proved, we shall find in it the explanation of the variable red colour which is always observed at the rising and setting of the sun. The consequences of this discovery will doubtless be obvious to all. We have at length arrived at the origin of a considerable portion of the lines of the solar spectrum, and the acquaintance with these will permit us to study the most elevated strata of our atmosphere, till now inaccessible to our means of investigation. But it is especially in astronomy that the unfolding of these results will be so interesting.

Relying upon the precise knowledge of the spectrum of aqueous vapour, I anticipate being able very soon to ascertain distinctly the presence of this important element of organic life in the atmospheres of the planets and other stars. Even now I am able to announce that this vapour does not form part of the solar atmosphere.

Electric Buoys.—The experiments made at Cherbourg, by order of the Minister of the Marine, on the electric buoys of M. Emile Duchemin, have succeeded perfectly. It appears certain that henceforth the current from these very simple batteries can be economically and efficiently employed for the preservation of the iron hulls and armour plates of vessels. We understand that the zinc carbon and salt-water battery of M. Duchemin is used very advantageously in almost all the telegraphic stations of Switzerland.—*Les Mondes.* [In what does the novelty of this form of battery consist?—Ed. C. N.]

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION.—*Friday, June 8, 1866.*

On the Source of Muscular Power, by Edward Frankland, *Ph.D., F.R.S., Professor of Chemistry, R.I.*

(Concluded from page 152.)

Playfair's Determinations.

Actual Energy developed by One Gram of various Articles of Food when oxidised in the Body.

Name of food.	Metrekilograms of force. Dry.	Natural condition.
Cheshire cheese	2429	1846
Potatoes	1563	422
Apples	1516	273
Oatmeal	...	1665
Flour	...	1627
Pea-meal	...	1598
Ground rice	...	1591
Arrowroot	...	1657
Bread crumb	1625	910
Lean of beef	2047	604
Ditto veal	1704	496
Ditto ham, boiled	1559	711
Mackerel	2315	683
Whiting	1675	335
White of egg	1781	244
Hard-boiled egg	2562	966
Yolk of egg	2641	1400
Gelatin	1550	...
Milk	2046	266
Carrots	1574	220
Cabbage	1543	178
Cocoa nibs	...	2902
Butter	...	3077
Beef fat	3841	...
Cod liver oil	3857	...
Lump sugar	...	1418
Commercial grape sugar	...	1388
Bass's ale, bottled	1559	328
Guinness's stout	2688	455

Weight and Cost of various Articles of Food required to be oxidised in the Body in order to raise 140 lbs. to the height of 10,000 ft.

External work = $\frac{1}{5}$th actual energy.

Name of Food.	Weight in lbs. required.	Price per lb. s. d.	Cost. s. d.
Cheshire cheese	1·156	0 10	0 11½
Potatoes	5·068	0 1	0 5¼
Apples	7·815	0 1½	0 11¾
Oatmeal	1·281	0 2¾	0 3½
Flour	1·311	0 2¾	0 3⅝
Pea-meal	1·335	0 3½	0 4⅔
Ground rice	1·341	0 4	0 5⅓
Arrowroot	1·287	1 0	1 3½
Bread	2·345	0 2	0 4⅔
Lean beef	3·532	1 0	3 6½
,, veal	4·300	1 0	4 3½
,, ham boiled	3·001	1 6	4 6
Mackerel	3·124	0 8	2 1
Whiting	6·369	1 4	9 4
White of egg	8·745	0 6	4 4½
Hard-boiled egg	2·209	0 6½	1 2⅔
Isinglass	1·377	16 0	22 0½
Milk	8·021	5d. per quart	1 3½
Carrots	9·685	0 1½	1 2½
Cabbage	12·020	0 1	1 0½
Cocoa-nibs	0·735	1 6	1 1⅛
Butter	0·693	1 6	1 0⅝
Beef fat	0·555	0 10	0 5⅔
Cod-liver oil	0·553	3 6	1 11⅛
Lump sugar	1·505	0 6	1 3
Commercial grape sugar	1·537	0 3½	0 5⅜
Bass's pale ale (bottled)	9 bottles	0 10	7 6
Guinness's stout	6¾ ,,	0 10	5 7½

Weight of various Articles of Food required to sustain Respiration and Circulation in the Body of an average Man during 24 hours.

Name of Food.	Weight in oz.	Name of Food.	Weight in oz.
Cheshire cheese	3·0	Whiting	16·8
Potatoes	13·4	White of egg	23·1
Apples	20·7	Hard-boiled egg	5·8
Oatmeal	3·4	Gelatine	3·6
Flour	3·5	Milk	21·2
Pea-meal	3·5	Carrots	25·6
Ground rice	3·6	Cabbage	31·8
Arrowroot	3·4	Cocoa-nibs	1·9
Bread	6·4	Butter	1·8
Lean beef	9·3	Cod-liver oil	1·5
,, veal	11·4	Lump sugar	3·9
,, ham, boiled	7·9	Commercial grape sugar	4·0
Mackerel	8·3		

These results are in many instances fully borne out by experience. The food of the agricultural labourers in Lancashire contains a large proportion of fat. Besides the very fat bacon which constitutes their animal food proper, they consume large quantities of so-called apple dumplings, the chief portion of which consists of paste in which dripping and suet are large ingredients—in fact, these dumplings frequently contain no fruit at all. Egg and bacon pies and potato pies are also very common *pièces de résistance* during harvest-time, and whenever very hard work is required from the men. The speaker well remembers being profoundly impressed with the dinners of the navigators employed in the construction of the Lancaster and Preston Railway: they consisted of thick slices of bread surmounted with massive blocks of bacon, in which mere streaks of lean were visible. Dr. Piccard states that the chamois hunters of Western Switzerland are accustomed, when starting on long and fatiguing expeditions, to take with them, as provisions, nothing but bacon-fat and sugar, because, as they say, these substances are more nourishing than meat. They doubtless find that in fat and sugar they can most conveniently carry with them a store of force-producing matter. The above tables affirm the same thing. They show that ·55 lb. of fat will perform the work of 1·15 lb. cheese, 5 lbs. potatoes, 1· lb. of flour or peameal, or of 3½ lbs. of lean beef. Donders, in his admirable pamphlet "On the Constituents of Food and their Relation to Muscular Work and Animal Heat," mentions the observations of Dr. M. C. Verloren on the food of insects. The latter remarks, "Many insects use, during a period in which very little muscular work is performed, food containing chiefly albuminous matter; on the contrary, at a time when the muscular work is very considerable, they live exclusively, or almost exclusively, on food free from nitrogen." He also mentions bees and butterflies as instances of insects performing enormous muscular work, and subsisting upon a diet containing but the merest traces of nitrogen.

We thus arrive at the following conclusions:—

1. The muscle is a machine for the conversion of potential energy into mechanical force.

2. The mechanical force of the muscles is derived chiefly, if not entirely, from the oxidation of matters contained in the blood, and not from the oxidation of the muscles themselves.

3. In man the chief materials used for the production of muscular power are non-nitrogenous; but nitrogenous matters can also be employed for the same purpose, and hence the greatly increased evolution of nitrogen under the influence of a flesh diet, even with no greater muscular exertion.

4. Like every other part of the body, the muscles are constantly being renewed; but this renewal is not perceptibly more rapid during great muscular activity than during comparative quiescence.

5. After the supply of sufficient albuminised matters in the food of man to provide for the necessary renewal of the tissues, the best materials for the production, both of internal and external work, are non-nitrogenous matters, such as oil, fat, sugar, starch, gum, &c.

6. The non-nitrogenous matters of food, which find their way into the blood, yield up all their potential energy as actual energy; the nitrogenous matters, on the other hand, leave the body with a portion (one-seventh) of their potential energy unexpended.

7. The transformation of potential energy into muscular power is necessarily accompanied by the production of heat within the body, even when the muscular power is exerted externally. This is, doubtless, the chief, and probably the only, source of animal heat.

ACADEMY OF SCIENCES.

September 24.

THE sitting this day was a very short one, but several papers of interest were brought forward. The first was

"*On Wine: its Maladies and their Causes; New Methods of Preserving and Aging it*," by M. Pasteur. The above is the title of a book which the author presented to the Academy, accompanying it with some remarks. The first part of the work contains a description of the maladies of wine, and the ferments which occasion them. The second part treats of the influence of oxygen in vinification. The third part explains an industrial process of preserving wines, which it is expected will produce considerable profit. The process has been tried by a great number of persons, and the results are said to be very favourable to the new process. The criterion to which final appeal was always made was tasting by a commission composed of experienced persons, and details are given of the results of experiments on twenty-one samples of wine.

"*Note on Galvanic Piles with Two Liquids*," by M. Zaliwski-Mikorski. The author has introduced an improvement in the method of filling and emptying the trough. The permanent part consists of an alternate succession of porous diaphgrams and isolated carbons. By means of tubes in the lower part, a liquid poured into one compartment immediately flows into all the analogous compartments; the whole of them can likewise be emptied simultaneously with a siphon. The trough therefore need not be moved when it has to be filled or emptied. The zincs, which are loose, rest on the carbon, which projects for this purpose at its base, and the effect of removing one or more is not to stop, but only to diminish the intensity of, the current. The cement consists essentially of sulphur rendered less brittle by admixture with tar and lamp black.

"*New Considerations on the Movements of Subterranean Materials in Fusion*," by M. A. de Caligny.

"*On the Polymeres of Acetylene, Second Part*," by M. Berthelot. This is a continuation of the paper given by the same author last week, and will be laid before our readers in full. In the condensed liquid obtained by passing acetylene through a red-hot tube, he finds diacetylene,

$$C_8H_4 = 2C_4H_2,$$

triacetylene or benzol,

$$C_{12}H_6 = 3C_4H_2,$$

and tetracetylene or styrolene,

$$C_{16}H_8 = 4C_4H_2.$$

In the higher boiling portions he finds naphthaline, derived from five molecules of acetylene and the loss of hydrogen,

$$C_{20}H_8 = 5C_4H_2 - H_2,$$

pentacetylene,

$$C_{20}H_{10} = 5C_4H_2,$$

and towards the boiling point of mercury he obtains enneacetylene or retene,

$$C_{36}H_{18} = 9C_4H_2.$$

"*On the Isomeric States of Styrolene*," by M. Berthelot. The formula $C_{16}H_8$ represents two hydrocarbons obtained by different ways—one from extract of storax, in which it pre-exists; the other from the decomposition of cinnamates. By some chemists these have been considered different bodies, and by others identical. M. Berthelot has examined them, and found decisive differences between them. The carbide from cinnamates has no rotatory power, whilst that from storax deviates the plane of polarisation −3 degrees. The two carbides, mixed with concentrated sulphuric acid, disengage unequal quantities of heat, the proportion being three to four, the greatest quantity corresponding to the carbide from storax.

"*On Hydrated Peroxide of Copper*," by M. C. Weltzien. When peroxide of hydrogen is added to a solution of ammonio-sulphate of copper, there is a lively disengagement of oxygen, and an olive-green precipitate is produced, which is doubtless identical with the peroxide of copper obtained by Thenard and Boettger. The formula appears to be H_2CuO_3. The author gives several reactions of peroxide of hydrogen, and some theoretical considerations.

"*On the Silkworm Disease*," by MM. Joly and M. F. Achard. These are two separate papers on a subject which is attracting great attention in France.

NOTICES OF BOOKS.

A Dictionary of Chemistry. By H. Watts, B.A., F.R.S. Part XXXVI.

This standard work is rapidly approaching completion. The October part embraces from *Saccharum* to *Silica*, and includes salicine; the salicylic compounds; an excellent memoir on *salt*, by Professor Fuster, in which he defines the modern idea of a salt as implying "the capability of readily undergoing double decomposition;" a good article on secondary alcohols; and a full account of selenium and its manifold combinations.

Zeitschrift für analytische Chemie. Edited by Dr. C. Remigius Fresenius. First Part. 1866.

As we before had occasion to remark, this very valuable contribution to analytical and abstract chemistry does not make its appearance with any regularity, for we have only just received the first part of the volume for 1866. We hasten to lay before our readers a list of its contents, and will lose no time in translating and printing, either in full or in abstract, those papers which are likely to be of more particular interest. The number consists of 140 well-printed pages, and contains:—

"*On the Detection and Estimation of Tannic Acid*," by P. Wagner.

"*On the Estimation of Mixtures of Organic and Inorganic Substances in River, Spring, and Mineral Waters*," by W. Heintz.

"*On the Separation and Isolation of Organic Matter in Spring and Potable Waters*," by J. Löwe.

"*On the Elementary Analysis of Hygroscopic Substances*," by W. Stein.

"*On the Detection of Free Acid in Alum*," by M. Derselbe.

"*On a Process of Gas Volumetric Analysis*," by E. Dietrich.

"*On the Action of Reagents on Diabetic Urine*," by G. Bizio.

"*On the Quantitative Determination of the Nitrogen and Oxygen dissolved in Water*," by O. Helm.

"*On the Estimation and Separation of Protoxide of Manganese from Proto- and Per-oxide of Iron*," by E. Reichardt.

"*On Gas Analysis*," by M. Derselbe.

"*On the Estimation of Bromine in Organic Bodies*," by R. L. Maly.

"*On Filtration*," by V. Prittmitz.

"*On the Presence of Magnesia in Commercial Baryta Salts*," by W. Reuling.

The following are communications from Professor Fresenius's laboratory at Wiesbaden:—

"*On the Separation of Cobalt and Nickel*," by F. Gauhe.

"*On the Behaviour of Soda, Lime, Caustic Potash Solution, Hydrate of Potash, and Potash Pumice Stone, towards Gases containing Carbonic Acid*," by R. Fresenius.

"*On the Application of Dialysis to the Detection of Poisonous Alkaloids*," by A. Cossa.

The remainder of the part is occupied with extracts from English and foreign journals, most of which have already been noticed in these pages.

Chemisches Central Blatt, Nos. 41 and 42.

The former of these two numbers contains the following articles extracted from the *Annalen der Chemie und Pharmacie* for June and July:—

"*On the Action of Nitric Acid on Glycolamidic Acid*," by W. Heintz.

"*On the Action of Nitrate of Potash on Salts of Triethylamine, and on the Separation of Diethylamine from Triethylamine*," by W. Heintz.

"*On Cratanic Acid*," by C. Bulk.

"*On the Periodides of Organic Bases*," by W. A. Tilden (from the *Journal of the Chemical Society*).

No. 42 contains articles "*On the Tar Dyes*," and on "*Chemical Researches on the Influence which a Variation of the Quality of the Food of Sheep exerts on their Excreta*," by Dr. E. Reichardt.

The usual short notices of papers are given in each number.

Journal für praktische Chemie. No. 13. August, 1866.

The present part of this journal contains the following papers:—

"*On the Formation of Peroxide of Hydrogen by the gradual Oxidation of Organic Matter in Towns.*" By C. F. Schönbein.

"*On the Formation of Active Oxygen by the Gradual Oxidation of Volatile Organic Substances.*" By C. F. Schönbein.

"*On Bromide of Benzylidene, and Two Derived Hydrocarbons.*" By C. A. Michaelsun and E. Lippmann.

"*On the Salts of Thialdine.*" By E. Brusewitz and M. Calhander.

"*On Pyromucic Acid.*" By MM. Schmelz and Beilstein.

The number contains several other papers; but as they are extracted from the *Comptes Rendus*, or from English journals, and have already been noticed in our columns, it is not necessary to refer to them a second time.

Blue Ink from Prussian Blue. — By the following process M. Vogel has always obtained a good solid blue ink with Prussian blue and oxalic acid:—Dissolve in a matrass, in a large quantity of water, ten grammes of sulphate of protoxide of iron; boil, and then add sufficient nitric acid to sesquioxide all the iron. Then add a solution of yellow prussiate of potash, containing ten grammes of this salt, and leave the precipitate to deposit. After decanting the supernatant liquid, throw the deposit on a filter, wash it with cold water, and leave it to drain until it can be easily raised from the filter with a knife. Then, without further drying, mix it in a porcelain mortar with two grammes of oxalic acid in crystals. Let the reaction continue for an hour, then gradually add 400 cubic centimetres of water. This produces a dark blue solution, which, even after long standing, does not precipitate.—*Moniteur Scientifique.*

NOTICES OF PATENTS.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W. C.

2236. J. M. Mellor, Broadway, New York, U.S.A., "Softening, disintegrating, and bleaching vegetable fibres."—Petition recorded August 30, 1866.

2252. A. Lebandy, Spring Gardens, Westminster, "An improved solder or composition for joining certain metals, or uniting fractures in certain metals, and for aimilar uses." A communication from C. Halot, Brusaels.—September 1, 1866.

2255. S. Vickess, Liverpool, "An improved method of and apparatus for facilitating the moving of moulds and the draining of ayrup from the sugar solutions and augar in the said moulds in the manufacture of sugar."

2266. C. E. Brooman, Fleet Street, "A new method of bleaching fibres and fabrics of vegetable origin." A communication from C. M. T. du Motay and C. R. Maréchal, Metz, France.—September 3, 1866.

2273. A. Paraf, Manchester, and J. A. Wanklyn, London, "Improvements in the extraction of iodine and bromine from kelp."—September 4, 1866.

2278. T. G. Webb, Manchester, "Improvements in furnaces for the manufacture of glass, commonly called melting furnaces."—September 5, 1866.

2323. W. E. Gedge, Wellington Street, Strand, "Improvements in the manufacture of calcareous bricks or artificial stones." A communication from A. F. Osselin, Faubourg St. Martin, Paris.—September 10, 1866.

2331. W. Olley, Enfield, Middlesex, "Improvements in apparatus for separating animal and vegetable matters from water and other liquids."—September 11, 1866.

Invention Protected by the Deposit of a Complete Specification.

2415. A. B. Berard, Avenue Montaigne, Paris, "Improvements in the manufacture of steel, and in the apparatus employed therefor, parts of which improvements and apparatus are also applicable to the production of gas for heating purposes."—Petition recorded September 20, 1866.

CORRESPONDENCE.

"Isinglass" for Smelting Furnaces.

To the Editor of the Chemical News.

Sir,—Referring to the question at the end of your last number as to the meaning of the word "isinglass" in a paragraph from the *Mechanics' Magazine*, I beg to offer the following attempt of an explanation:—When I read the same paragraph a few weeks ago, I was naturally struck with its apparent absurdity; but I soon consoled myself with the assumption that the writer might have somehow confounded "isinglass" with "marienglass," the German name for the highly transparent variety of gypsum. If this were the case, there would be no flagrant nonsense in the proposal of using the substance in question in constructing smelting furnaces; but I am very far from committing myself to any approval of that scheme.

I am, &c., G. L.

South Shields, September 30.

To the Editor of the Chemical News.

Sir,—According to Dr. Dana's "Manual of Mineralogy," p. 33, under head "Cleavage," "mica" is often improperly called "isinglass." Perhaps this substance is meant in the paragraph of the *Mechanics' Magazine* alluded to in your notice to "J. W." last week. Let us hope that such improper use of terms may for the future be banished this country at least, even if tolerated in America.

I am, &c., J. O.

On the Results of the Micro-Chemical Examination of Extract of Flesh.

To the Editor of the Chemical News.

Sir,—In the Chemical News of September 14, appears a verbatim report of a paper read by Messrs. Deane and Brady before the British Pharmaceutical Conference on the examination of *extractum carnis* by the microscope, in which, after detailing their experiments, the authors state that they have arrived at the following conclusions:—"That the microscope does afford a ready means of ascertaining proximately the value of this article;" and 2nd. "That the value of a sample is in direct relationship to its crystalloid, and inversely to its colloid, constituents"—a result so much at variance with that arrived at by Baron Liebig, the learned demonstrator of the process for making this article, that I venture to trouble you with a quotation from his "Letters on Chemistry," p. 420, where, speaking of the crystalline constituents of the extract of flesh, the learned chemist says: "All these substances constitute but a small part of the extract of flesh. By far the greater part of it consists of uncrystallisable (colloid) compounds, the properties of which have not yet been sufficiently studied. To these substances belong the savoury constituents of the juice of flesh, and those among them which become so easily brown when gently heated." So much difference is apparent in these opinions, that it is absolutely necessary to have further proofs of the constituents of extractum carnis before expressing an opinion as to the quality of any particular make.—I am, &c.

F. D.

MISCELLANE OUS.

Eclipse of the Sun.—On Monday next, October 8, there will be a partial eclipse of the sun. It will begin in London at 26 m. past 4 p.m., and will be at its maximum at 26 m. past 5; but the sun will set at 21 m. past 5, when something less than half the sun's diameter will be eclipsed. Observers situated in other parts of the kingdom will be able to observe the greatest obscuration before sunset. Thus:—

	Eclipse begins.	Maximum obscuration.	Sun sets.
London (Greenwich time)	4.26	5.26	5.21
Oxford (local time)	4.20	5.20	.20
Liverpool ,,	4.8	5.10	5.19
Edinburgh ,,		5.5	5.16
Dublin ,,	3.52	4.56	5.19

The Sodium Amalgamation Process.—From an article in our excellent contemporary, the *American Artisan*, we learn that a paper was read before the American Association for the Advancement of Science at its recent session in Buffalo, N. Y., by Professor Wurtz. From it we make the following extracts:—"Some objections to the use of sodium for silver ores, on the part of a Californian metallurgist named Kustel, were briefly discussed. Kustel has erred mainly in supposing that the purpose of the sodium-amalgam was to *decompose* silver ores by extracting their sulphur by sheer force of chemical affinity. The rapid and perfect collection and separation from a slime or pulp of contained and diffused silver-amalgam by the use of sodium-amalgam would alone give it an obvious importance; but it has other values when properly understood. Kustel's experiments, having been based upon an incorrect idea of the mode of action, have but little applicability *pro* or *con*, and inconsistencies were pointed out in his conclusions. Kustel's conclusion, that iron pans cannot be used with sodium, for instance, is shown to be fallacious by very numerous working results now on record. Mr. Kustel, however, admits the value of sodium for gold ores, and others in California experienced in amalgamation do not concur with Mr. Kustel in his opinion

with regard to silver ores. . . . The most surprising articles elicited by this discovery in Transatlantic journals have emanated from certain persons who have denied the authenticity of the discovery altogether, and claimed that the use of sodium in amalgamation of ores has already actually been a matter of publicity for centuries. Mr. John Calvert and another writer (anonymous) have put forth the astounding assertion that extracts can be given from more than one hundred works in various languages, showing that not only sodium, but magnesium, has been used in this way from time inmemorial. Three very ancient works are referred to by name—Schwartz's 'Alchymia de Salabus,' Albaro Alonso Barba's 'Art of Metals,' and Roger Bacon's 'Ars Omnia.' Professor Wurtz has examined the work of Barba, written in 1640, and finds nothing in it indicating in the remotest degree any knowledge of sodium, much less of its use in amalgamation; and has examined Mr. Calvert's translated extracts from the Latin manuscript of Bacon, which it appears was never published, and finds in them only some obscure allusions as to what wondrous magic might be worked by a pinch of salt in transmuting a mass of worthless stuff into gold. Schwartz's still older work Professor Wurtz has been unable to find in this country, but thinks it may be said with reason that a person of lively imagination could find plainly set forth in the jargon of the alchemists every one of the discoveries of the nineteenth century, besides a multitude of other discoveries either yet to be made or never to be made. Respecting the recent and wonderful announcement from an unknown source, so widely and persistently paraded in the public press, of the amazing *explosiveness* of an amalgam of sodium, it appears that this was simply an ingenious but futile *commercial trick*—the motive for it having been the hope of embarrassing the transportation and introduction of the amalgams of sodium into the mining regions, by those legitimately entitled to introduce it, until the completion of certain arrangements for infringing upon the patent rights.

Solubility of Paraffin.—Aug. Vogel has determined the solubility of paraffin in benzol, chloroform, and sulphide of carbon. The paraffin experimented with melted at 48° C., and congealed at 45°. The benzol had the ap. gr. 0·887. One part of benzol

at 46°	C.	dissolved	7·7 parts paraffin.
43°	,,	5·0	,,
39°	,,	4·0	,,
23°	,,	0·7	,,
20°	,,	0·3	,,

Solubility in chloroform: One part of chloroform at 23° dissolved 0·22 parts paraffin; one part of chloroform at 20° dissolved 0·16. Solubility in sulphide of carbon: One part of the sulphide of carbon at 23° dissolved an equal weight of paraffin. Comparative experiments with stearic acid showed that one part of benzol at 23° C. dissolved 0·22 parts of stearic acid, and one part of sulphide of carbon at 23° dissolved 0·3 of stearic acid. This acid is consequently less soluble in the above menstrua than paraffin. A mixture of stearic acid and paraffin fused together did not separate from these solutions in a homogeneous mass, but in two layers, the stearic acid appearing in distinct crystals. This may suggest a method of recognising the presence of stearic acid in a mixture with paraffin.—*Am. Drug. Circ.*

Cement for Rooms.—An invention by M. Sarel, of Paris, is stated to be superior to plaster of Paris for coating the walls of rooms. It is used as follows:—A coat of oxide of zinc, mixed with size, made up like a wash, is first laid on the wall, ceiling, or wainscot, and over that a coat of chloride of zinc applied, being prepared in the same way as the first wash. The oxide and chloride effect an immediate combination, and form a kind of cement, smooth and polished as glass, and possessing the advantages of oil paint without its disadvantages of smell.—*Dublin Med. Press.*

Creosote.—Dr. A. E. Hoffmann* purified creosote, which he had obtained warranted from beechwood tar, according to Von Gorup-Besanez's method by distillation, and only used such as began to boil at nearly 203°. The boiling point rose to 208°. This distillate agrees in all physical attributes with that described by Von Gorup-Besanez; only the specific gravity was greater, 1·075 (1·040 according to Gorup-Besanez). From an examination of the chemical behaviour, the inference drawn is, that creosote is only imperfectly pure carbolic acid. Hexachlorxylon is identical with chloranil. Von Gorup-Besanez† contradicts this, and dismisses Hoffmann's supposition that he was working with beechwood tar creosote as untenable, as it has entirely disappeared from German commerce. Accordingly, Hoffmann's research would merely amount to a statement of the long-known fact that carbolic acid may be bought for creosote—not, however, that true creosote does not exist.

Chloride of Barium.—According to Godin, a process lately patented in Belgium for preparing this salt consists in melting together a mixture of sulphate of baryta, charcoal, limestone, and chloride of calcium. During the operation, the charcoal reduces the sulphate of baryta to sulphide of barium, and this forms, with chloride of calcium by double decomposition, chloride of barium and sulphide of calcium; this latter again combines with the lime produced by the decomposition of some of the limestone, forming an insoluble oxysulphuret of calcium. The chloride of barium is now separated from the calcined mass by lixiviation and evaporation. The proportions used are 100 parts native sulphate of baryta, 35 to 50 parts charcoal, 15 to 25 parts limestone, and 40 to 60 parts chloride of calcium.—*Dingl. Polyt. Journ.*

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

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F. T.—We must decline to write trade puffs.

Owen.—Chloroform will remove the stains of dry paint much better than turpentine, and will leave no unpleasant odour behind.

Pharmaceutist.—The presence of nitric acid will prevent the precipitation of bismuth salts by water. This fact has been made use of for some time in the preparation of Liquor Bismuthi.

W. M. M.—The Hindustani name for indigo is *Nil*, or the blue dye. The word aniline is derived from this.

Cantor Lectures.—We have received the copy for these valuable lectures, lately delivered by Dr. F. Crace Calvert before the Society of Arts. Their publication will commence almost immediately.

Distiller.—The fœtid smell of your carbolic acid is due to the presence of sulphur compounds of some of the higher acids. It can be removed by rectification from oxide of lead.

X. Y. Z.—To purify the nitrate of baryta, dissolve in hot water and add strong nitric acid. This will precipitate the nitrate of baryta in the form of a snow-white crystalline powder. Collect on a funnel partially closed with a glass rod, wash once with nitric acid, and dry at 212°.

E. M. Nash.—We shall be pleased to hear further particulars, as the subject is one of some importance. Respecting the Paris Exhibition, your best plan will be to apply to the Secretary of the Exhibition Committee, South Kensington Museum. But we think you are too late to obtain space.

Books Received.—Dictionary of Chemistry, by Henry Watts, B.A., F.C.S., &c. (Part XXXVI.); Technologist for October; Antiseptic Treatment of Cholera, by Dr. A. E. Sansom.

* *Journ. f. prakt. Chem.*, Bd. xcvii., S. 225.

† *Ibid.*, Bd. xcvii., S. 63.

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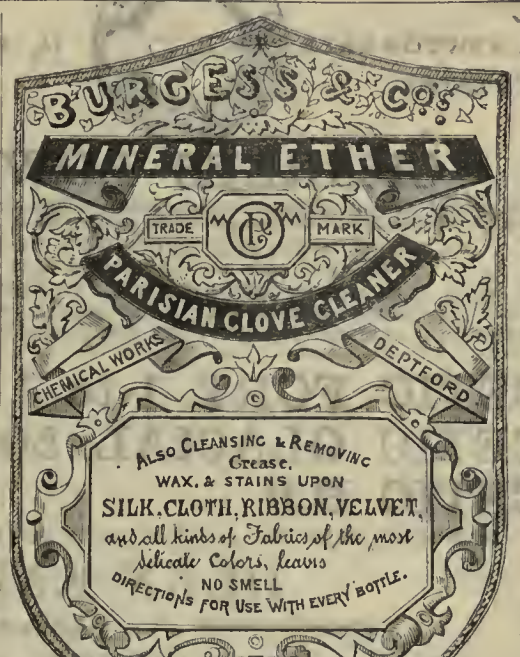

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DISINFECTION AND THE CHOLERA.

A STARTLING assertion has been made by a Dr. Saunders, to the effect that carbolic acid is of no special value in preventing the spread of infectious disease, and that, in fact, its very general employment during the recent visitation of cholera has been productive of more harm than good. In a report which he has just issued to the guardians of the City of London Union, he winds up an intemperate attack on the City Commissioners of Sewers in the following terms:—

"During the last few weeks the streets of the City have been abundantly supplied with a solution of carbolic acid, and its nauseous and suffocating odour has polluted the atmosphere night and day, ostentatiously appealing to the olfactories of the million, in proof of the vigilant care of the Commissioners of Sewers. It has been sought to justify this process upon the purely hypothetical grounds that the air we breathe contains floating animal or vegetable organisms supposed to be the germs or nidus of cholera, and that these are rendered harmless by the action of this disgusting agent. I need not say that modern scientific investigation fails to justify any such proposition; far better would it have been for the general welt-being of the community if the energies of the Commissioners had been directed into the more practical operation of searching out the causes of disease in the courts and alleys of the poor."

Now, such statements as these, emanating as they do from a Medical man occupying, we believe, a responsible position in the City of London, and who may therefore be supposed to know something of the history and literature of the modern doctrines of disinfection, must not be passed over without notice. The subject is one which is interesting to all chemists, as it is mainly through the researches and exertions of some of our fraternity that the antiseptic treatment of zymotic diseases has so widely prevailed; it especially affects ourselves, inasmuch as from the first we have consistently and emphatically urged the extension to cholera, of those chemical processes of disinfection and prevention, which proved so efficacious in arresting the cattle plague; and it is mainly through our exertions that carbolic acid has met with such extended application in London. It certainly cannot be denied that, simultaneously with this wholesale employment of the most powerful antiseptic known, the cholera has, contrary to all previous experience and present anticipation, not only ceased to spread, but appears to be steadily on the decline.

It is a notorious fact that the odour of carbolic acid, especially when diluted, is rather pleasant than otherwise; yet Dr. Saunders has the hardihood to speak of polluting the atmosphere by its nauseous, suffocating, and disgusting odour. Medical and scientific journals for months past have been filled with experimental researches and theoretical arguments, which have placed in the strongest light the two facts that carbolic acid is, perhaps, the most energetic known destroyer of animal ferments and poisons, and that the cholera is propagated by the diffusion of an animal ferment or poison. Carbolic acid and the cholera poison thus appear to be placed by modern scientific research in the natural relationship of poison and antidote, acid and alkali; and yet Dr. Saunders, with the researches of Dr. Lionel Beale, Dr. Angus Smith, and other well-known experimentalists staring him in the face, by a strange perversion of language, attempts to bias the minds of those who naturally look to him for correct information, by the specious phrase—"I need not say that modern scientific investigation fails to justify" this employment of carbolic acid. It is to be hoped that those to whom this report is addressed will know what value to place on opinions expressed with such temerity.

It will be remembered that, in some remarks which we made on the subject of disinfection a few weeks ago, we called attention to the fact that in the parish of St. Pancras the sewers were being disinfected on alternate days with oxidising and deoxidising agents. This was mentioned quite incidentally, and with no particular desire to cast any blame on the parish authorities, but merely as an illustration of the waste of material occasioned by the want of accurate knowledge of the laws of disinfection, and the absence of combined action among the local self-governing authorities. To this statement Mr. Worrell, Chief Clerk of the St. Pancras Department of Works, has written a reply, in which, after first denying the facts mentioned by us, he says:—"During the autumn of last year, and since the spring of this year, the district sewers of St. Pancras have been deluged only with carbolic acid, principally of MacDougall's manufacture. . . . . We also put chloride of lime into the gullies discharging into main line sewers, so that there might be no neutralising effects. Chloride of lime was also used dry for gullies having catch pits. . . . This course was approved by Dr. Hillier, the Medical Officer of Health, whose abilities as a chemist are a sufficient warranty for the correctness of the course adopted."

This statement is almost sufficient in itself to justify the remarks which we felt it our duty to make, but the facts, as observed by us, are even stronger than those mentioned by Mr. Worrell. In three, and doubtless more, streets in the immediate neighbourhood of Mr. Worrell's office, on one morning in the early part of August, the passer-by was assailed by the powerful odour of chloride of lime, and on every grating leading into the drains an abundance of this powder was seen to be strewed. Two days after, this was replaced by another powder of a slightly yellowish cast, and the prevailing odour now was that of carbolic acid. Suspecting that this might be MacDougall's powder, some of it was collected and submitted to analysis. This confirmed our suspicions, and proved that carbolic acid and sulphite of lime and magnesia—powerful *deoxidising* agents—were being added to the sewers. The next day chloride of lime had resumed its sway, and, to complete the evidence, some of this was collected and examined; this, we need scarcely add, is a powerful *oxidising* agent. Mr. Worrell further says that "the use of chloride of lime has not taken place for many weeks past, it having

been found more expensive and less effective and lasting than carbolic acid, which is now employed freely both in powder and solution in all parts of the parish." So we are justified in concluding that the changes have again been rung on oxidisers and deoxidisers.

The above observations and analyses were made personally by the Editor of this Journal, and the arguments based upon them cannot therefore be considered either out of place or unjust to those responsible for this scientific incongruity.

TECHNICAL CHEMISTRY.

On Sodium Amalgamation, with Special Reference to saving the Precious Metals, and especially Gold, by Professor E. SILLIMAN. (*Abstract.*)

SAMPLES of waste or "tailings" collected by myself at various amalgamation works in Grass-valley, California, a place noted above most others for the great success which has attended amalgamation of gold, proved on assay to contain in the quartz waste over 30 dollars to the ton, and in the sulphides over 50 dollars to the ton, showing a loss nearly equal to the average amount saved in that district. One of the most cautious and experienced metallurgists of California, at one time connected with the geological commission of that State, informed me that by his own determinations the saving in a large number of cases was barely 30 per cent. of the gross contents of the ore, as shown by careful assays both of the ore and the waste. The causes of this large loss are various, amongst which may be mentioned imperfect processes, insufficient comminution of the ore, and the difficulty of bringing the gold into contact with the mercury. In an ore containing one ounce of gold to the ton of quartz or waste, the ratio is as 1 to 32,000, or less than one-fourth of one grain in one pound of stuff. It is, however, well known to all who are conversant with gold amalgamation that the mercury often appears perfectly indifferent to the gold, even when brought in contact with it, failing to amalgamate with it. This indifference may sometimes be traced to a minute portion of grease, which effectually checks amalgamation, but it is quite as often due to some other and less obvious cause, baffling often the skill of the best amalgamators, and resulting often in a ruinous loss of the precious metal. Numerous inventions have been devised to save this loss and avoid the causes which involve it, but until lately with very indifferent success. One of the most promising—viz., the use of mercurial vapour—has proved itself, on trial in the large way, a failure, and the problem has remained in a great measure unsolved. It was communicated to me, as the result of preliminary experiments, that the use of a minute portion of the metal sodium would impart to mercury the power of amalgamating with gold readily under any of the adverse conditions which had thus far proved so serious a drawback to the practice of this art. I have the honour to place before the Academy two of the alloys thus formed. The one contains about 2 per cent. of sodium, crystallised in beautiful prismatic crystals and needles, as may be observed, and melts below 212° Fahr. The other contains about 4 per cent., commonly rather more, of sodium, and is a hard brittle solid, remarkably infusible, and requiring a temperature nearly as high as the fusing point of type metal to melt it, and which may be cast into ingots, and packed either under petroleum or in air-tight iron cans, filled with dry lime. This harder alloy may be fused in free mercury at a temperature below its point of vaporation. But for practical use it will doubtless be found more convenient to employ one of the more fusible alloys of sodium. This amalgam may be most conveniently transported by employing the common iron quicksilver bottles, which, being filled with the alloy and tightly closed, will need no other protection from the air, and by setting the flask in boiling water a short time the alloy becomes liquid, and may then be used to charge the ordinary quicksilver for use.

Experiments upon Gold Ores.—Having at my disposal a considerable quantity of California quartz from a mine in Calaveras county, I proposed subjecting these ores to amalgamation, under conditions subject to control, both as expressing the actual value of the material experimented on, as well as giving the value of the results and the loss in the process. For this purpose recourse was had to the crushing and grinding apparatus of Mr. M. B. Dodge, in New York city, which, doing its work dry, gives unusual facilities for exactness. The details obtained in these experiments as to the degree of comminution reached by this apparatus have been very carefully worked out, but are reserved for a future communication, having no bearing on the subject now before us, although believed to be of value to the art of ore dressing. Suffice it to say, we were able by this means to obtain a fair average sample of the entire amount of the ores treated—a thing of the greatest practical difficulty, as every assayer well knows.

First Series of Experiments.—One lot of very poor ores, being quartz, showing no gold, but some iron pyrites and much ochery matter, being crushed and ground, gave of fine dry powder 525 lbs. Several assays of this lot gave an average value to the ore on the ton of 2000 lbs.—

Gold.	$13·56
Silver	1·33
	$14·89

The whole of this lot of 525 lbs., or rather more than a quarter of a ton pulverised ore, was then treated in a Freiberg amalgamating pan, provided with sixteen mullers, and driven by steam power. In this apparatus the mass was first made into a thin paste with water, and then treated for one hour with 20 lbs. of mercury, to which 4 oz. of 4 per cent. sodium amalgam were added in four successive doses, applied at about equal intervals during the time of the process, the alloy being dissolved in a small part of the mercury. On cleaning up the results of the experiment and obtaining as nearly as possible average samples of the waste, the entire amount of mercury used in the experiment was recovered with a loss of less than $\frac{1}{320}$th of the original quantity. On careful distillation (retorting) the button of bullion melted at the United States Assay-office gave 1·925 of one ounce troy of a fineness of 827-thousandths, and a value of 3·295 dol., or calculated upon the ton of 2000 lbs., giving a value per ton of 14 dol. 3 c. of precious metal. The tailings from this experiment yielded to assay a mere trace of gold, too small to be weighed. The concentrated sulphides washed from the tailings, and representing a very small fraction of the whole original mass, gave as the result of two assays—1183 dol. 73 c., and 1140 dol. 63 c.; average 1162 dol. 18 c. per ton of 2000 lbs. On calculating the ratio of these concentrated tailings to the whole mass, it was found to be as 1 to 1700, giving about 70 cents as the bullion

value additional to the bullion obtained by amalgamation, giving a total of 14 dol. 73 c., and differing by only 16 cents from the entire chemical contents, as shown by the average of several assays—in other words, the sodium amalgamation had in this experiment saved, practically speaking, all the gold in an ore containing less than 15 dols. to the ton.

Second Series of Experiments.—Another lot of ores from the same mine, known to be much richer than the first, was in like manner ground to a fine powder, and very carefully sampled in a manner to secure a fair average.

Repeated assays, at the United States Assay Office and elsewhere, fixed the value of this sample of about 80 lbs. of powdered ore at 320 dol. per ton, the range of difference being moderate.

The assay gave respectively 293 dol. 63 c., 332 dol. 78 c., 296 dol. 37 c., 368 dol. 22 c., 306 dol. 20 c., 320 dol. 36 c. The average result of the value of the whole quantity being very closely 320 dol. per ton of 2000 lbs. of ore. In treating this sample, a different mode of experimenting was adopted. A small rotating cask, capable of treating 10 lbs. or 15 lbs. of ore, was arranged in imitation of the usual Freiberg barrel. In operating on small quantities of ore (10 lbs. or 15 lbs. for example), the ratio of loss and error is much higher than in treating larger quantities, as in the great processes of the arts. We did not expect, therefore, to obtain in this series of experiments results so closely approximating the assay as in the first experiment, which was made upon a scale equal to that of the quartz mill.

Experiments.—I. To make a comparative experiment, showing the relative saving power of common quicksilver and of the sodium amalgam, 5 lbs. of the ore were treated for thirty minutes with 2 lbs. of common mercury, which gave—

		Per cent.
Per ton of 2000 lbs. . . .	$118 80 c.	or 37·12
The tailing of this experiment, panned by hand with one ounce of magnetic mercury, yielded an additional quantity . .	$67 20 c.	or 21·00
	$186 00 c.	or 58·00

II. 10 lbs. of the ore were next treated in the same manner with 1 lb. of common mercury thirty minutes, and the tailings panned in like manner with 1 oz. of magnetic quicksilver, giving in all, per ton, 182 dol. 60 c., or 57·1 per cent.

III. 10 lbs. of the ore, with 1 lb. of common quicksilver, for thirty minutes—

Yielded	$191 80 c., or 60 p. c.
Tailings treated for thirty minutes with 1 lb. of magnetic quicksilver (quarter of an ounce of No. 2 amalgam) gave in addition . . .	$63 60 c., or 20 p. c.
	$255 40 c., or 80 p. c.

No appreciable loss of mercury.

IV. 10 lbs. of the ore treated for thirty minutes with 1 lb. of magnetic quicksilver (one quarter of an ounce of No. 2 amalgam), and the tailings, as in No. II., treated in a pan with one ounce magnetic quicksilver, yielded in all 266 dol. 40 c., or 83·3 per cent.

No appreciable loss of mercury.

General Results.—These experiments are still in progress, but the results show that with unaided mercury the gold saved is less than 60 per cent. of the whole quantity of gold known to be present. In one experiment less than 40 per cent. was saved, while by the aid of the amalgam of sodium the saving is increased to 80 or 83·3 per cent., or an increase of more than 20 per cent.; leading to the reasonable expectation that in the large way at least 80 per cent. of the gold present in a given case may be saved, and in many cases, where the gold is coarse and free, that even better results than this may be attained. The first experiment detailed, in which a different amalgamating apparatus was used, gave results surprisingly close. I do not think the barrel as good a form of apparatus for this description of amalgamation as some one of the numerous forms of pan now in use. It was employed in these experiments simply because it was a convenient means of treating small quantities of ore in making comparative experiments. Experiments in California, under my direction, have been set on foot upon a scale of magnitude adequate to test the value of the discovery in the metallurgy of gold in a satisfactory manner, the results of which may be looked for at no distant day.

The action of the sodium in this case appears to be in a manner electrical, by placing the mercury in a highly electro-positive condition towards the electro-negative gold. The quantity of sodium is too small to allow the supposition that it acts by its chemical affinities. It is well known to chemists that the metallic sulphides are decomposed by amalgam of sodium, but no one supposes that an inventor could be found so Quixotic in his chemical notions as to seriously propose the use of sodium amalgam as a means of effecting the reduction of the sulphides of silver, &c., since not less than one equivalent of sodium would be required to set at liberty one equivalent of silver. The use of sodium amalgam for silver amalgamation must depend upon a like power of electrical action to that seen in its action on gold, and also to the well-known power of preventing the granulation (flouring) of mercury, or of saving the mercury when thus changed. Indeed, there is good reason for believing that a most important part is played by the sodium amalgam in this last particular. The amalgam of gold or silver is very liable, as every millman knows to his loss, to granulate and disappear from the plates of the battery, or from the ripples, after it has once been formed. If this granulation takes place, it is almost impossible, by the existing modes of amalgamation, to recover the minute particles which float off with the currents of water, and are lost. The action of the sodium in recovering mercury which has passed into this condition is perhaps its most remarkable property.

Alta California, March 13.

On Resins,* by M. H. Violette.

Calcutta copal resins, which form the basis of varnish, are not naturally soluble in ether, essence of turpentine, benzol, petroleum, and other hydrocarbons, nor in vegetable oils.

These resins become soluble, cold or hot, when, by previous distillation, they have lost 25 per cent. of their weight.

The present memoir comprises some new researches which may be summed up as follows:—

1. The above-mentioned resins being heated in a closed vessel, at a temperature between 350 and 400°, acquire after cooling, without losing any of their weight, the property of dissolving, hot or cold, in the above-named liquids, and forming excellent varnishes, without any loss of substance.

* *Comptes Rendus*, lxiii., 461.

2. Calcutta copal resin, heated as above with one-third of drying linseed oil and one-third of essence of turpentine, gives directly, without any loss, a rich, clear, limpid varnish, of a beautiful slightly lemon colour, perfectly adapted for carriages, and for the inside as well as outside of rooms, where delicate painting is required.

Under the double influence of heat and pressure, resins then acquire new properties; this, measured by the manometer, amounts to twenty atmospheres. It must be left to manufacturers to overcome the difficulty of transferring this new method from the laboratory to the factory.

PHARMACY, TOXICOLOGY, &c.

The Exhibition of the Pharmaceutical Conference, Nottingham.

(*Continued from page* 162.)

From Messrs. Davy, Yates, and Routledge, there were forwarded a large series of metallic and other preparations. Among them we noticed:—*Ferri et quiniæ citras*, in scales of a fine greenish golden-yellow colour, freely soluble in water, and yielding a clear, bright solution. It contains 16 per cent. of pure quinia, which is equivalent to 25 per cent. of citrate. The process of the B. P., when strictly adhered to, produces scales of somewhat duller colour than those in the sample above referred to. *Ferri et ammoniæ citras*, made by saturating citric acid with metallic iron, adding liq. ammoniæ until the white proto-citrate is dissolved, and exposing the solution to atmospheric air until oxidised. The liquor is then evaporated to a syrupy consistence, and scaled by exposing to a temperature of 80° to 100° Fahr. in thin layers on glass or earthenware plates. The scales thus produced are of a garnet-red colour, are readily soluble in water, and have a slightly ferruginous taste. *Ferri percitras*, in fine garnet-coloured scales, prepared by dissolving freshly-precipitated hydrated sesquioxide of iron in citric acid, and scaling as described in the remarks respecting ferri et ammon. cit. It has an acid and slightly styptic taste. *Ferri pyrophosphas*, in beautiful golden green scales. Its chemical composition is not, however, accurately represented by the name it bears, it being prepared by dissolving pyrophosphate of iron in a mixture of the citrates of soda and ammonia; the solution is then evaporated to a syrupy consistence, and scaled in a similar way to the ferri et ammoniæ citras. *Iodo-cyanide of potassium and mercury*, prepared by mixing strong solutions of bicyanide of mercury and iodide of potassium in equivalent proportions. The salt is deposited in white, pearly, crystalline plates. Its chief use is to detect the presence of small quantities of the mineral acids in hydrocyanic acid. *Benzoic acid*, made from gum benzoin, in soft, feathery, pearly crystals. When thus made it is much preferred to that obtained from the urine of some graminivorous animals, as it then cannot altogether be deprived of a disagreeable odour by repeated sublimation. *Potass. permanganas*, in fine iridescent needles. *Iodide and bromide of cadmium. Bromide of ammonium, and chloride of gold*, principally used for photographic purposes. Bromide of ammonium was lately in considerable demand as a remedy for whooping-cough. The iodide of cadmium exhibited is in fine crystals. *Valerianate of iron*, made according to the process of the Dublin Pharmacopœia. It is almost entirely soluble in spirit, but not perfectly so, which is seldom practically the case when the salt is thus prepared, owing to a slight decomposition which takes place while drying. *Naphthaline.* When purified by sublimation, it forms, as in the specimen shown, large brilliant crystalline plates of a pearly lustre. *Bismuth. et ammon. citras*, only lately introduced into pharmacy. The specimen exhibited is in minute scales, containing 60 per cent. of oxide of bismuth, and is readily soluble in water, differing in this respect from other salts of bismuth, which are decomposed and precipitated by water. It is prepared by precipitating a solution of nitrate of bismuth with an alkaline citrate, collecting and washing the precipitate with water, dissolving it in liq. ammoniæ, and drying on glass plates at a temperature of between 90 and 100° Fahr. If too great a heat be employed, it is liable to be rendered insoluble. *Potassæ borotartras* (soluble cream of tartar) may be prepared in the form of scales, as exhibited, by dissolving together boracic acid and cream of tartar in water, evaporating to a syrupy consistence, and scaling on glass plates. Thus prepared, it presents an appearance far superior to the amorphous powder which is more often sold as soluble cream of tartar, and which is made from cream of tartar and borax. *Acetate of amyl* (essence of pear), *valerianate of amyl* (oil of apple), and *butyrate of ethyl* (essence of pineapple), the principal ingredients used in the manufacture of the fruit essences, which are now made in such considerable quantities. By judicious admixture, artificial essences may be obtained, resembling very closely the flavour of almost every kind of fruit. *Podophyllin*, a resinous substance obtained from the root, or rather rhizome, of the *Podophyllum peltatum*, now an article of the British Pharmacopœia, sometimes called vegetable calomel. It varies much in colour, from a dark brown to a greenish or yellowish tint, is practically insoluble in water, and soluble in alcohol and ether. It is prepared by exhausting the crushed rhizome with spirit, the greater portion of which is afterwards distilled off, and pouring the concentrated solution into water previously acidulated with hydrochloric acid; the precipitated resin is then collected, washed, and dried at a low temperature.

Mr. Daniel Hanbury forwarded a large case of medicinal fruits derived from the order Scitamineæ.

Messrs. Hearon, M'Culloch, and Co., sent a series of the leading drugs, selected from a number of samples forwarded to them by a merchant in China, for the purpose of ascertaining their market value in this country. They have been examined both by Dr. Lockhart and Daniel Hanbury, Esq., who state that, although they meet with a ready sale in China, and are considered useful remedies, they possess few properties sufficiently prominent to render them important as medicinal agents amongst ourselves—none to qualify them to displace those we are accustomed to see prescribed in this country—and must therefore be regarded as mere curiosities. They are mostly infused, and taken in combination in considerable quantities, and possess in some slight degree either tonic, stomachic, or demulcent properties. The essential oils (otto ?) of roses and elder flowers are curious by reason of their scarcity and costliness, the product of either being so small that if the flowers were distilled for the purpose of obtaining these alone, and not as by-products, their respective values would amount to about 20*l.* per oz. The quantity of otto of roses exhibited is the result of the distillation of about 300 bushels of flowers. Elder flowers do not yield nearly so much in proportion, and therefore it would not have been commercially practicable to prepare the water as recommended by the London College in their Pharmacopœia

of 1836—viz., by using 2 drachms of the essential oil as a substitute for 10 lbs. of the flowers, for this would be equivalent to a very much larger quantity. The concentrated infusions, preserved juices, liquid and solid extracts, comprise the leading preparations of both the London and British Pharmacopœias, placed side by side for the purpose of contrast.

The well-known firm of Morson and Son forwarded a few specimens for exhibition, comprising globules containing pepsine, pancreatine, and charcoal. These globules are a convenient form for administering these and other medicines. They also exhibited specimens of pancreatine or pancreatic oil in both an acid and alkaline state, with an emulsion formed from the latter, which has the advantage of greater stability and can be kept without change or putrefactive fermentation. Specimens of *meconine* and *narceine*, two of the least abundant alkaloids of opium, the latter body having recently obtained considerable reputation in France and Germany as a most valuable sedative, applicable in cases in which morphia and other preparations of opium cannot safely be administered. The small quantity of this alkaloid present in opium, and its consequent high price, will of necessity limit its use to cases in which other narcotics are inadmissible. A specimen of pepsine prepared by a modification of the process of Dr. Pavy, by which, if carefully followed out, the greatest digestive activity of this body appears to be obtained. A preparation of the cuticle of wheat, to which the name of saccharative wheat phosphates has been given; this preparation has been used and recommended for some years by Dr. Tilbury Fox. The peculiar digestive principle of bran will not, like pepsine, digest animal matter, but seems peculiarly suited for the digestion of farina.

(To be continued.)

On the Purification of Quinoidine, by M. de* Vry.

Commercial quinoidine is never pure; M. de Vry has proved it to contain sometimes as much as 30 per cent. of foreign matters. His purifying process is founded on M. Pasteur's observation that nine parts of quinoidine triturated, and kneaded a long time in a mortar with a diluted solution of two parts of neutral oxalate of ammonia, end by entirely dissolving, while disengaging ammonia, and abandoning the foreign matters. But while M. Pasteur operated at the ordinary temperature, M. de Vry advises the use of heat.

The following is the process by which he proposes to purify quinoidine, and consequently to render it fit for medicinal purposes. Boil, in an iron vessel, nine parts of quinoidine, with a diluted solution of two parts of neutral oxalate of ammonia, until ammonia ceases to be disengaged. As part of the insoluble matter will attach itself to the sides of the vessel while boiling, add distilled water from time to time, so that this part may be covered during the boiling, and thus be continually in contact with the ammoniacal solution. As soon as ammonia ceases to be disengaged, let the liquid get quite cold, and if the addition of water does not cause it to become turbid, dilute it with that liquid. Then filter the liquid, and precipitate it in a capsule by means of an excess of caustic soda solution.

Collect, by means of gentle heat, the glutinous precipitate at the bottom of the capsule, then decant the clear alkaline liquid, and wash the precipitate of quinoidine several times in distilled water. Then expose the still glutinous quinoidine thus purified for some time to a temperature of 100° to 110° C., which will thus lose the little water it retained, and finally become, when cold, hard and friable. Oxalate of ammonia is used for the purpose of getting rid of the lime usually contained in commercial quinoidine.

* *Journal de Pharmacie et de Chimie*, iv., 50.

PROCEEDINGS OF SOCIETIES.

BRITISH ASSOCIATION, NOTTINGHAM MEETING.

Friday, August 24.

A Lecture "On the Results of Spectrum Analysis, as applied to the Heavenly Bodies," by William Huggins, *F.R.S.*

An important invention or discovery seldom, if ever, remains sterile and alone. It gives birth to other discoveries. The telescope and the microscope have led to remarkable discoveries in astronomy and in minute anatomy and physiology, which would not have been possible without those instruments. The observation that a magnetic body, free to move, arranges itself nearly north and south, has not only contributed immensely to the extension of commerce and of geographical discovery, but also has founded the important science of terrestrial magnetism.

This evening I have to bring before you some additions to our knowledge in the department of astronomy, which have followed from a comparatively recent discovery. The researches of Kirchhoff have placed in the hands of the astronomer a method of analysis which is specially suitable for the examination of the heavenly bodies. So unexpected and important are the results of the application of spectrum analysis to the objects in the heavens, that this method of observation may be said to have created a new and distinct branch of astronomical science.

Physical astronomy, the imperishable and ever-growing monument to the memory of Newton, may be described as the extension of terrestrial dynamics to the heavens. It seeks to explain the movements of the celestial bodies on the supposition of the universality of an attractive force similar to that which exists upon the earth.

The new branch of astronomical science which spectrum analysis may be said to have founded, has for its object to extend the laws of terrestrial physics to the other phenomena of the heavenly bodies, and it rests upon the now established fact that matter of a nature common to that of the earth, and subject to laws similar to those which prevail upon the earth, exists throughout the stellar universe.

The peculiar importance of Kirchhoff's discovery to astronomy becomes obvious, if we consider the position in which we stand to the heavenly bodies. Gravitation and the laws of our being do not permit us to leave the earth; it is, therefore, by means of light alone that we can obtain any knowledge of the grand array of worlds which surround us in cosmical space. The star-lit heaven is the only chart of the universe we have, and in it each twinkling point is the sign of an immensely vast, though distant, region of activity.

Hitherto, the light from the heavenly bodies, even when collected by the largest telescopes, has conveyed to us but very meagre information, and in some cases only of their form, their size, and their colour. The discovery of Kirchhoff enables us to interpret symbols and indications hidden within the light itself, which furnish trustworthy information of the chemical, and also, to some extent, of the physical, condition of the excessively remote bodies from which the light has emanated.

We are indebted to Newton for the knowledge that the beautiful tints of the rainbow are the common and necessary ingredients of ordinary light. He found that when white light is made to pass through a prism of glass it is

decomposed into the beautiful colours which are seen in the rainbow. These colours, when in this way separated from each other, form the spectrum of the light. Let this white disc represent the transverse section of a beam of white light travelling towards you. Let now a prism be interposed in its path. The beam of white light is not turned aside as a whole, but the coloured lights composing it are deflected differently, each in proportion to the rapidity of its vibrations. An obvious consequence will be, that, on emerging from the prism, the coloured lights which formed the white light will separate from each other, and in place of the white light which entered the prism we shall have its spectrum—that is, the coloured lights which composed it—in a state of separation from each other. Wollaston and Fraünhofer discovered that when the light of the sun is decomposed by a prism, the rainbow colours which form its spectrum are not continuous, but are interrupted by a large number of dark lines. These lines of darkness are the symbols which indicate the chemical constitution of the sun. It was not until recently, in the year 1859, that Kirchhoff taught us the true nature of these lines. He himself immediately applied his method of interpretation to the dark lines of the solar spectrum, and was rewarded by the discovery that several of the chemical elements which exist upon the earth are present in the solar atmosphere.

It is my intention to bring before you this evening the results of the extension of this method of analysis to the heavenly bodies other than the sun. These researches have been carried on in my observatory during the last four years. In respect of a large part of these investigations—viz., those of the moon, the planets, and fixed stars—I have had the great pleasure of working conjointly with the very distinguished chemist and philosopher, Dr. Wm. Allen Miller. Before I describe the results of our observations, I will state, in a few words, the principles of spectrum analysis upon which our interpretation of the phenomena we have observed has been based, and also the method of observing which we have employed.

When light which has emanated from different sources is decomposed by a prism, the spectra which are obtained may differ in several important respects from each other. All the spectra which may present themselves can be conveniently arranged in three general groups. A spectrum illustrating each of these three orders is placed upon the diagram.

1. The special character which distinguishes spectra of the first order consists in that the continuity of the coloured band is unbroken either by dark or bright lines. By means of the electric lamp, Mr. Ladd will throw a spectrum of this order upon the screen. We learn from such a spectrum that the light has been emitted by an opaque body, and almost certainly by matter in the solid or liquid state. A spectrum of this order gives to us no knowledge of the chemical nature of the incandescent body from which light comes. In the present case, the light is emitted by the white-hot carbon points of the electric lamp. A spectrum in all respects similar would be formed by the light from incandescent iron, or lime, or magnesia.

2. Spectra of the second order are very different. These consist of coloured lines of light separated from each other. From such a spectrum we may learn much. It informs us that the luminous matter from which the light has come is in the state of gas. It is only when a luminous body is free from the molecular trammels of solidity and liquidity that it can exhibit its own peculiar power of radiating some coloured rays alone. Hence substances, when in a state of gas, may be distinguished from each other by their spectra. Each element, and every compound body that can become luminous in the gaseous state without suffering decomposition, is distinguished by a group of lines peculiar to itself. These green lines are produced by silver in a state of gas, and only by silver gas. It is obvious that if the groups of lines characterising the different terrestrial substances be known, a comparison of these as standard spectra, with the spectrum of light from an unknown source, will show whether any of these terrestrial substances exist in the source of the light.

3. The third order consists of the spectra of incandescent solid or liquid bodies, in which the continuity of the coloured light is broken by dark lines. These dark spaces are not produced by the source of the light. They tell us of vapours through which the light has passed on its way, and which have robbed the light by absorption of certain definite colours or rates of vibration; such spectra are formed by the light of the sun and stars.

Kirchhoff has shown that if vapours of terrestrial substances come between the eye and an incandescent body, they cause groups of dark lines; and further, that the group of dark lines produced by each vapour is identical in number and in position in the spectrum with the group of bright lines of which its light consists when the vapour is luminous.

Mr. Ladd will throw upon the screen the spectrum of incandescent carbon points which contain sodium. Observe in addition to the continuous spectrum of the incandescent carbon, a bright yellow band, which indicates the presence of sodium. Now a piece of metallic sodium will be introduced into the lamp. The sodium will be vaporised by the heat, and will fill the lamp with its vapour. This vapour absorbs, quenches the light that it emits when luminous. There will thus be produced a black line exactly in the place where the bright yellow line was.

It is evident that Kirchhoff, by this discovery, has furnished us with the means of interpreting the dark lines of the solar spectrum. For this purpose it is necessary to compare the bright lines in the spectra of this light of terrestrial substances when in the state of gas, with the dark lines in the solar spectrum. When a group of bright lines coincides with a similar group of dark lines, then we know that the terrestrial substance producing the bright lines is present in the atmosphere of the sun. For it is this substance, and this substance alone, which, by its own peculiar power of absorption, can produce that particular group of dark lines. In this way, Kirchhoff discovered the presence of several terrestrial elements in the solar atmosphere.

METHODS OF OBSERVATION.

I now pass to the special methods of observation by which, in our investigations, we have applied these principles of spectrum analysis to the light of the heavenly bodies. I may here state that several circumstances unite to make these observations very difficult and very irksome. In our climate, on few only even of those nights in which the stars shine brilliantly to the naked eye, is the air sufficiently steady for these extremely delicate observations. Further, the light of the stars is feeble. This difficulty has been met, in some measure, by the employment of a large telescope. The light of a star falling upon the surface of its object-glass of eight inches aperture is gathered up and concentrated at the focus into a minute and brilliant point of light.

Another inconvenience arises from the apparent movement of the stars, caused by the rotation of the earth, which carries the astronomer and his instruments with it. This movement was counteracted by a movement given by clockwork to the telescope in the opposite direction. In practice, however, it is not easy to retain the image of a star for any length of time exactly within the jaws of a slit only the 1-300th inch apart. By patient perseverance these difficulties have been overcome, and satisfactory results obtained. We considered that the trustworthiness of our results must rest chiefly upon direct and simultaneous comparison of terrestrial spectra with those of celestial objects. For this purpose we contrived the apparatus which is represented in the diagram.

By an outer tube the instrument is adapted to the eye-end of the telescope, and is carried round with it by the clock motion. Within this outer tube a second tube slides, carrying a cylindrical lens. This lens is for the purpose of elongating the round point-like image of the star into a short line of light, which is made to fall exactly within the jaws of a nearly-closed slit. Behind the slit, an achromatic lens (and at the distance of its own focal length) causes the pencils to emerge parallel. They then pass into two prisms of dense flint glass. The spectrum which results from the decomposition of the light by the prisms is viewed through a small achromatic telescope. This telescope is provided with a micrometer screw, by which the lines of the spectra may be measured.

The light of the terrestrial substances which are to be compared with the stellar spectra is admitted into the instrument in the following manner:—

Over one-half of the slit is fixed a small prism, which receives the light reflected into it by the moveable mirror placed above the tube. The mirror faces a clamp of ebonite, provided with forceps to contain fragments of the metals employed. These metals are rendered luminous in the state of gas by the intense heat of the sparks from a powerful induction coil. The light from the spark reflected into the instrument by means of the mirror and the little prism passes on to the prisms in company with that from the star. In the small telescope the two spectra are viewed in juxtaposition, so that the coincidence and relative positions of the bright lines in the spectrum of the spark, with dark lines in the spectrum of star can be accurately determined.

(To be continued.)

ACADEMY OF SCIENCES.

October 1.

The first article read at this meeting was, "*On the Porosity of Caoutchouc relative to the Dialysis of Gases*," by M. Payen. The author refers to the important discovery of Professor Graham, who considers it demonstrated that a thin film of caoutchouc has no porosity because it is absolutely impervious to gaseous air. M. Payen asserts that ordinary caoutchouc contains true pores, and under the microscope they are readily visible, especially when in contact with a liquid. When immersed in water, caoutchouc absorbs 18 or 20 per cent., and becomes white and opaque, the opacity being evidently due to the introduction of water by capillarity into the porous substance. This is different from the penetration of water into a homogenous mass, such as gelatine (among colloids) which will absorb fifty times its weight of water, and pectic acid, and gelose, which will take up more than double this quantity. The porosity of caoutchouc is not only rendered evident in the presence of water; cold or warm alcohol will show it, as also will fused sulphur, which, at the temperature of 115° or 120°, will penetrate without sensibly exerting chemical action. These phenomena of capillarity must not be confounded with the effects produced by liquids which have a solvent action—such as sulphide of carbon, ether, benzol, and many hydrocarbons, which, partly dissolving the substance, cause it to swell up and lose its pores. The author has also shown that water, by opening the pores of the caoutchouc, can pass through a film of it and evaporate on the opposite side. Gutta percha in the form of thin sheets, as left when a solution in sulphide of carbon is allowed to evaporate on a glass plate, also contains pores which can be detected under the microsope. By strong traction this porosity becomes transformed into a fibrous texture.

"*On the Application of the Silvering Process to an Object-glass 25 Centimetres in Diameter*," by M. Leverrier. At the sitting on September 3, M. Foucault brought forward a process for weakening the solar radiation by covering the object-glass with a film of silver. Since then, M. Secretan has allowed the experiment to be tried on a large object-glass of the above diameter, and the result has satisfactorily proved that the anticipations which a trial on a small glass led the inventor to entertain were fully justified. The image of the sun is freed from almost all the heat and excess of light which render observation difficult and dangerous; the interposition of the film of silver appears in no way to alter the optical properties of the lens; it only diminishes the intensity of the transmitted light without affecting the path of the rays and without producing sensible diffusion. Under favourable atmospheric conditions a power of 300 diameters could be applied, and the entire surface of the sun was observed to be covered with those numerous details which have been described by the most experienced observers. At times it was seen that advantage would have been derived from the application of a much higher power. The transmitted light is bluish, but the eye soon gets accustomed to it; the spectroscope shows that all the rays of the spectrum are present, except the extreme red—the orange, yellow, and green undergoing partial extinction.

"*Note on the Tendency of any Material System to a State of Absolute or Relative Repose*," by M. A. Dupré. The author proves that every material syatem has a tendency to assume a state of relative or absolute repose; without being able to point out the time which will elapse before it attains its ultimate state. Also, every material system in which we observe actual relative movements, and consequently gradual declension, has had a commencement; for, if we suppose the contrary, we shall at last arrive at a time when the sum of the losses of *distance* will surpass the equivalent of the heat contained in the system when arrived at its final condition—which is absurd. Applying these conclusions to the material world considered as a whole, we see that the existence of the movements which produce those harmonies which we admire in the works of the Creator, is sufficient to prove that they have have had a supernatural commencement, whilst they tend towards a natural termination.

"*On M. Cavana's Hydraulic Motor*," by M. Muller. M. Cavana has constructed a machine of 450-horse power, which is worked by the motive force of sea or river water.

"*Application of the Principle of the Transparency of Metals*," by M. Melsens. The author has applied M. Foucault's principle to darkening spectacle glasses used in cases of injury to the eye. He covers the pale blue glasses with a leaf of gold or silver applied mechanically. He finds that the light transmitted under these conditions is of particular softness, and suggests that gilded or silvered glasses might be useful in many cases of photophobia.

"*On the Action of Nitrate of Silver and Protonitrate of Mercury on Bichloride of Platinum*," by M. A. Commaille. In Dumas' "*Traité de Chimie*," and Cahours' "*Traité de Chimie*," the action of nitrate of silver on bichloride of platinum is stated to be entirely different. The author has consequently re-examined the question, and finds that on mixing these two salts together an abundant yellow precipitate is produced, and the liquid becomes decolorised on standing or when heated; this precipitate does not blacken in sunlight. Ammonia, after prolonged contact, removes all the chloride of silver, leaving protochlorlde of platinum, whilst warm hydrochloric acid changes all this chloride of platinum into bichloride, with a residue of chloride of silver; thus confirming Dumas' statement. Analysis of the yellow precipitate gave the formula—

$$AgCl + 2\,(PtCl).$$

When protonitrate of mercury is mixed with chloride of platinum, a somewhat complicated reaction takes place, the result depending upon the temperature, the bulk of the liquids, and the order of their addition.

NOTICES OF BOOKS.

The Elements of Chemistry, Inorganic and Organic. By J. C. Buckmaster. Third edition. London: Longman and Co.

This work is divided into two parts, the former of which treats of inorganic chemistry (184 pp.), and the latter of organic chemistry (96 pp.). The organic portion has been prepared by Mr. Rowden. At the end of the book there is an appendix containing questions on chemistry "given at the examination of science schools and classes," and at an "examination for science certificates," both examinations being those held under the science and art department. Some of these questions are followed by answers, and the book terminates with an "explanation of some of the terms used in chemistry," and a short index.

The ultimate object of this treatise (we learn from the preface) is to promote "the scientific education of the senior classes in middle-class schools;" but "pupil-teachers, schoolmasters, and the students of classes in mechanics' institutions" are expected to find the work to be "not without its value." An advertisement sheet enclosed in the volume contains several testimonials to the effect that these objects have been pretty well realised. So serious a mistake, however, must not be allowed to pass unnoticed. The manual itself is obviously the production of persons having very little practical acquaintance with the subjects of which they treat. It abounds with loose statements, inaccuracies as to fact, and very important omissions. An endeavour is made to shield these by a seductive appearance of clearness and compression. We will substantiate these charges by adducing a few out of many particular instances which the book presents to us.

At page 1 we are told that "chemistry investigates the relationship between the different kinds of atoms or particles of which these materials (constituting the earth) are composed." What is a student to make of this loose definition? As to the vague "relationship," on the understanding of which the whole definition turns, he will find no further allusion; but at page 49, a chemical reference is made to the atmosphere, though in an underhand sort of way, as if it were rather an intruder into the subject. The atoms themselves, so far as we can learn, are mainly considered as undergoing analysis or synthesis—the author's two leading ideas with regard to chemical phenomena. Again, we are told at page 6, "If nitrogen and hydrogen be mixed in the same vessel, combination does not take place; but when these gases are set free at the same time, as in the case of manure-heaps, ammonia is formed." Now, the author evidently does not mean to say that these gases are set free at all in the latter case; for, if they were once set free, he would assert that they would not combine. Why should a "manure-heap" induce combination any more than a "vessel?"

The following are a few examples of inaccuracy as to fact. In the preface to this edition it is stated that Gerhardt's notation is to be used. Here are some examples:—

$Ba = 137$, $Ca = 40$, $Cu = 63{\cdot}4$, $Pb = 207{\cdot}4$.

At page 35 we have another blunder, which any well-trained beginner would never have made—

"(Steam), $H_2O + Fe = FeO + H_2$ free."

At page 44 we read: "From the chlorate of potassium chloric anhydride is obtained by boiling with a solution of hydrofluosilicic acid. The process is tedious and requires care." So tedious indeed that the operator would have to wait till the Greek kalends. A wrong account, also, is given (page 50) of what takes place when binoxide of manganese is heated to redness. "Two atoms of the oxide of manganese yield up an atom of oxygen, forming the sesquioxide, Mn_2O_3." The same is repeated at page 128. In the appendix, however (page 288), the right account of the reaction is given. But what would a student make of the three statements? Oxygen appears to have undergone a change in one important property: "it is not combustible—that is, it will not burn" (page 52). At page 55 we read that "there are seven oxygen compounds of sulphur." Five, however, of the bodies he mentions are perfectly unknown.

Neither under the head of "sulphuric acid," nor when treating of the *tests* for barium, is there the slightest mention of the precaution (which every teacher knows it is so absolutely necessary to enforce) to dilute the solutions. The term "molecular weight" does not occur. No account is given of the *laboratory* process for preparing hydrochloric acid. A figure of a Pepys' gasholder is left entirely without a description. Such are some of the omissions. Yet the author can find time to tell us about the preparation of red and green fire, and to give us particulars about the "washerwomen of Holland and Belgium."

The organic part has been written with more care, but with very little improvement in accuracy or precision. Here, for example, is a piece of confusion. At page 186 it is said—"Ferrocyanide of potassium may be regarded as the double cyanide of K and Fe;" but at page 190—"Such, however, is not the case." It appears from an equation at page 186 that when "dilute sulphuric acid" is boiled with "ferrocyanide of potassium" all the cyanogen is eliminated as hydrocyanic acid, which is certainly not the case. The practice of constructing equations from the imagination (of which there are plenty of instances in the volume) is much to be deplored; it renders the student's path easier, in most cases at the expense of truth. Cellulose, starch, and dextrine are represented (with a C_{12} formula) as isomeric bodies. Chloride of ethyl "is *usually* prepared by the action of terchloride of phosphorus on alcohol." Methyl "has not been isolated" (page 221). The formulæ of the alcohol radicals (page 226) have only half their proper value. "Benzol is *usually* prepared by distilling benzoic acid, &c., &c." (page 247). What has become of coal tar? *All* the initial equations given at pages 256-7 for the preparation of the ethylamines are practically false. Tannic acid is dismissed, in general terms, with four lines and a half; "Pharaoh's serpent" is described with detail in eight lines and a quarter. So closely do these two authors resemble each other!

We should not have reviewed this book at such length had we not deemed it a duty to warn students of the dangers into which they may fall by reading such productions. Bad grammar, confused statements, bad chemistry, and false chemistry are dear at any price; yet such a vicious collocation is the natural result of a system of examination which is contented with a very superficial general training, and does not require practical acquaintance with what is a pre-eminently practical subject. We are far from impugning the educational status of "certificated teachers" individually; but it is too much that the mere certificate as now granted should be taken as proving competence to *teach*. Can we be surprised that it should lead the less informed to write books?

We commend to the consideration of Mr. Buckmaster, his coadjutor, *and* the public one remarkable sentence which occurs in this manual at page 33, a sentence quite unexceptionable in every respect, and worth the whole cost of the treatise. It is this—"Nothing short of actually *doing* the thing will give the proper knowledge."

Journal de Pharmacie et de Chimie. September, 1866.

The first article in the present number is

"*On Medical Tinctures*," by M. Vuaflart. This article is written in consequence of a note published by M. Filhol in the July number of the *Journal de Pharmacie*. It discusses the relative values of tinctures made by displacement and by maceration.

"*On the Blue and Red Colouring Matters of Urine, Urocyanose, and Uroerythric Acid,*" by M. Fordos. The author believes that the blue colouring matter is due to the transformation or doubling, under the influence of acids, of an organic matter which is not precipitated by subacetate of lead, but which he has not yet succeeded in isolating. This blue matter is ordinarily accompanied by a red colouring matter, which it is easy to separate by means of solvents—the red colouring matter being more soluble in alcohol, chloroform, and benzol, than the blue colouring matter.

The blue matter may easily be obtained pure and crystalline; it appears under the microscope in the form of right-angled prisms of a magnificent blue colour. It differs by its crystallisation from indigo, which, however, it resembles in chemical properties. To detect traces of urocyanose in urine, mix in a test-tube one volume of urine with at least half a volume of hydrochloric acid, and in twenty or thirty minutes agitate with ether, which dissolves the urocyanose, and floats on the top with a blue colour. Chloroform may be used instead of ether, in which case the blue liquid sinks to the bottom of the liquid.

"*On the Carbonisation of Seaweeds, and the Extraction of Bromine and Iodine from them: Estimation of Iodine with Alkaline Hyposulphites,*" by M. E. Moride. This is a paper which we have already noticed, having been presented to the Academy of Sciences April 30. It contains nothing novel, and our only reason for again alluding to it is to correct a misstatement which the author again repeats —viz., that "Mr. Edward *Strandfort's* process for extracting bromine and iodine from seaweed has been abandoned." If by the above name Mr. E. C. C. Stanford's process is meant, we must inform M. Moride that it is at the present time being energetically and very successfully carried on in the Hebrides.

"*On the Niauli of New Caledonia,*" by MM. Gervais and Chatin. This medicinal plant appears to be the *Melaleuca viridiflora* of botanists. Its leaves are used for flavouring and for adulterating tea with.

"*On the Propagation of Electricity in a Solution containing several Salts,*" by M. E. Bouchotte. He finds that the electric conductivity of a mixture of solutions of salts is sometimes above and sometimes below the mean of the constituent solutions.

"*Report on a Formula for Ferruginous Syrup of Quinquina,*" by MM. Shaeuffèle, Goblez, and Baudrimont. This is on the subject of a letter addressed by M. E. V. Garnier to the Pharmaceutical Society of Paris. Our readers can judge of the tenor of this report by the following quotation:—"It appears to us that such discussions are always hurtful, especially for science, which ought only to inhabit those calm and serene regions in which the sterile noise of human passions should be allayed." Would that our Continental neighbours always bore in mind this necessity of scientific discussion!

"*Report on the Swiss Pharmacopœia,*" by M. Mayet.

"*On Alkaline Injections in the Veins during the Last Stage of Cholera,*" by Dr. Colson, of Beauvais.

"*Precautions to be taken during a Thunderstorm,*" by Dr. Sestier.

"*On the Therapeutic Applications of Donovan's Iodo-arsenical-Mercurial Liquid,*" by Dr. Pedrilli. The author says that this has been successfully employed in cases of syphilis.

"*On a New Glycerole: Glyconine,*" by M. E. Sichel. The author mixes four parts of yolk of egg and five parts of pure glycerine in a mortar. This forms a mass of the consistency of honey, and unctuous, like fat bodies. It is unalterable, having been left exposed to the air without injury for three years. Applied to the skin, it forms a varnish impervious to the air.

The remainder of the articles, which are very numerous, consist of quotations from the *Comptes Rendus* and various other journals, which have been already noticed in our columns.

Zeitschrift für Chemie. Nos. 15 and 16. 1866.

We give below the titles of the papers which appear in these numbers; translations or abstracts of the more important ones are in preparation.

"*Theoretical and Empirical Remarks on the Constitution of Glycol, and of the Acids derived from it.*" By L. Dossios.

"*On Drying Oil.*" By G. J. Mulder.

"*On Acetic Acid.*" By Dr. R. Brandes.

"*On Formic and Valerianic Acids.*" By Dr. E. Greiner.

"*On the Action of Nitric Acid on Glycolamidic Acid.*" By W. Heintz.

"*On the Action of Nitrate of Potash on Salts of Triethylamine, and on the Separation of Diethylamine from Triethylamine.*" By the same author.

"*On the Constitution of Anethol.*" By E. Erlenmeyer.

"*On the Constitution of Eugenol.*" By the same author.

"*On the Detection of Alkaloids.*" By M. Dragendorff.

"*On the Principal Archil Lichens, and their Colouring Matters.*" By O. Hesse.

"*On Isobutyric Acid and Pseudo-Propylethyl-Ether.*" By W. Markownikoff.

"*On the Isomorphism of Lithium Salts with Potassium and Sodium Salts.*" By C. Rammelsberg.

"*On Bromide of Selenium.*" By R. Schneider.

"*On Xylol Compounds.*" By A. Vollrath.

"*On the Reaction between Monacetic Glycol Ether and Mono-natrio-Glycolate.*" By Dr. R. Mohs.

"*On the Reaction between Alcoholate of Sodium and Iodide of Tetrethyl-Ammonium.*" By Dr. R. Mohs.

"*On Sulphobenzol.*" By M. Fleischer.

"*On Œnanthylidene and Caprylidene.*" By H. Limpricht.

"*Researches on Isomerism in the Fatty Acid Series.*" By W. Markownikoff.

"*On the Products of the Oxidation of Coal Tar Cumol (Trimethyl-Benzol).*" By G. Herzel and F. Bielstein.

"*On Crotonic Acid.*" By C. Bulk.

The few other papers which are contained in these numbers have already been noticed in the Chemical News.

NOTICES OF PATENTS.

101. *Treating Sewage and Urine.* Francis Sutton, Norwich. Dated January 12. (This invention received Provisional Protection only.)

The sewage, in order to be treated by this process, is run into tanks, and the precipitation of the solid matter takes place there. The patentee adds sulphate of alumina, which may vary in proportion from three to ten grains per gallon of sewage, either used alone or in conjunction with common clay, fullers' earth, burnt clay, bog ochre, sulphate of magnesia, or peroxide of iron, these substances being used in proportion according to the state of concentration in which the sewage exists. The settlement of all solid matters from the liquid takes place very rapidly, when the clear fluid can be run or pumped off for further treatment or for irrigation. In order to extract the ammonia, this liquid or urine, as the case may be, is now run into large tanks or pits having covers or other means of being closed tolerably tight, and fresh caustic lime added either in a slaked or unslaked condition in the proportion of about one pound to every hundred gallons of diluted sewage, and in larger proportion if the sewage or urine is in a concentrated state. Shallow trays of wood, porcelain, earthenware, or slate, containing sulphuric acid or hydrochloric acid either alone or mixed with sawdust, spent bark, tan, animal charcoal, wood charcoal, superphosphate of lime, earth, gypsum or peat, or with the manure produced from sewage by the precipitation process,

are then suspended immediately over the surface of the mixed sewage and lime. Fermentation is set up in a short time by the action of the lime upon the nitrogenous matters in the sewage, and ammonia evolved, which is immediately absorbed by the acid or acid mixture in the trays. When sufficiently saturated with ammonia, the contents of the trays may be mixed with ordinary artificial manures or with sewage manure, and fresh acid material placed above the liquor till it is exhausted, when it may be turned into rivers as harmless, and the precipitate used as manure.

The former portion of this patent appears of great value. We are, however, not aware whether it is prior to Mr. Bird's patented process for the use of sulphate of alumina for a similar purpose. The latter part of the patent, though ingenious, is, we fear, impracticable on a large scale.

No. 301. *Improvements in the Manufacture of Saltpetre and White Lead.* Clarence Delafield, of Staten Island, United States of America. Dated January 31, 1866.

The patentee commences by stating that the white lead of commerce, as manufactured after the old or what is known as the Dutch process, consists of the carbonate of lead united with the hydrated oxide of lead in about the proportion of two chemical equivalents of the carbonate of lead to one equivalent of the hydrated oxide of lead. The mechanical means and the chemical agencies employed in the manufacture of the white lead of commerce after the old process are familiar to every one skilled in the arts to which this invention appertains; but the formation and chemical union of the carbonate of lead and the hydrated oxide of lead which takes place in and forms a part of that process, is not so well understood. It is believed, however, that the acetic acid driven off from the vinegar by the heat induced by the fermentation of the tan bark or horse manure against metallic lead surrounded by an atmosphere of water vapour and carbonic acid gas forms oxide of lead, and these three chemical equivalents of the oxide of lead in process of formation take from this atmosphere one equivalent of water and two equivalents of carbonic acid gas, yielding as the result of the chemical action carbonate of lead united with the hydrated oxide of lead in about the proportion above stated. The patentee says that he has discovered that the white lead of commerce, instead of being made by the slow Dutch process, can be made very much quicker, and equally good or better, by making, manipulating, and uniting a solution of the nitrate of lead and a solution of the carbonate of potash in such a manner as to yield a precipitate of the carbonate of lead united with the hydrated oxide of lead, which is the white lead of commerce. The manner of making, manipulating, and uniting these solutions so as to obtain the above-mentioned result is as follows:—

First take from 112 to 124 parts of the nitric acid of commerce of about 36° Baumé; to this add 112 parts of the oxide of lead and sufficient water to make a saturated solution of the nitrate of lead; and in order to convert quickly the mixture of the nitric acid and the oxide of lead and water into a solution of the nitrate of lead, make the mixture hot. Then take about 70 parts of the purified carbonate of potash and dissolve it in its weight of water, forming a solution of the carbonate of potash and water, which also make hot. In making the solution of the nitrate of lead, use hot water, and raise the temperature of the mixture to about 200° of Fahrenheit. And in making the solution of the carbonate of potash use boiling water, the temperature of which is lowered by mixing in the potash, and which afterwards raise to about 200° of Fahrenheit. Having thus made and heated these solutions, throw the hot solution of the carbonate of potash into the hot solution of the nitrate of lead, by which the carbonate of lead at once precipitates and leaves the nitrate of potash in solution, while at the same time the precipitate carbonate of lead from crystallising is prevented, and a small proportion of the hydrated oxide of lead also gets in combination with the carbonate of lead. The result of this process is an approximation of what is sought for, but it does not yield so large a proportion of the hydrated oxide of lead in chemical combination with the carbonate of lead as is contained in the white lead of commerce. Now, in throwing the hot solution of the carbonate of potash into the hot solution of the nitrate of lead, there seems to be a complete chemical union between the carbonate of lead and the hydrated oxide of lead until about two-thirds of the alkaline solution has been added to the nitrate of lead solution, when the formation of the hydrated oxide of lead seems to stop, so that in adding the other third of the alkaline solution pure carbonate of lead is formed. It is, therefore, necessary to change the molecular formation of this remaining carbonate of lead by adding the necessary proportion of hydrated oxide of lead, for which purpose the patentee introduces into the tank containing the united solutions a jet of hot steam through metallic or flexible pipes, and continues the application until the whole solution or mass is thoroughly pervaded or heated by the steam, when it will be found that hydrate oxide of lead has been formed and united to the carbonate of lead in about the proportion above stated. The apparatus or means of applying the steam to the solution or precipitated salts may be varied to suit the circumstances or taste of the manufacturer, but it should be applied through pipes or orifices, and with sufficient force to diffuse it well through the solution or mass in case it be applied to the salt after precipitation. It what way the jet of steam operates upon the solution, salt, or mass, is difficult to affirm. The beneficial effect may be owing to the increase of temperature resulting from the introduction of the steam, or it may be owing to the electricity generated by the passage of the steam through the pipes, the electricity enlarging and accelerating the chemical combination that takes place between the elements present, be they what they may. The patentee inclines to the belief, however, that the same result will be obtained by raising the temperature of the combined solutions by the application of heat thereto, whether in the form of steam or in any other suitable form. But whatever may be the true theory in regard to the chemical action, the fact is, that by the introduction of the steam as above stated he gets the result sought for—that is, the white lead of commerce, quicker, whiter, and purer than can be obtained by the old or Dutch process. In stating the improvements in the manufacture of white lead, he has described his improvements in the manufacture of saltpetre also, for in the use of this process, after the salts of lead have been precipitated, he gets as a residue a hot solution of the nitrate of potash, which may be drawn off, evaporated, and rapidly crystallised into a very fine saltpetre of commerce.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W. C.

1859. L. Mignot, Faubourg St. Denis, Paris, "Improvements in the preparation of soluble alkaline silicates, to render them suitable for being used for preserving stone, wood, and other materials, and for manufacturing artificial stone, and for other purposes."—Petition recorded July 16, 1866.

2245. A. de la Gautraye, Belvedere Road, Lambeth, "An improved method for the preservation of wood." A communication from M. Manne, Rue des Sainta-Pères, Paris.—August 31, 1866.

2362. G. Robinson, Welbeck Street, Middlesex, "Improvements in the manufacture or production of ammonia, baryta, and strontia."—September 14, 1866.

CORRESPONDENCE.

The Source of Muscular Power.

To the Editor of the Chemical News.

Sir,—In your last number the concluding portion of my lecture on this subject is headed "Playfair's Determinations." As the determinations which immediately follow constitute the real hard work of my portion of the investigation, and as they were all made in the chemical laboratory of the Royal Institution, I cannot, in justice to this institution, allow the error to remain uncorrected.

I am, &c. E. Frankland.

Royal Institution, October 6.

Patent for Preparing Tetrachloride of Carbon.

To the Editor of the Chemical News.

Sir,—In the notices of patents published in No. 356 of the Chemical News, there is a description given of a process for "preparing tetrachloride of carbon," patented by Charles Crump, Yealmpton, Devon, Jan. 11, 1866. Allow me to ask Mr. Charles Crump, through the medium of your journal, whether he is aware that the process of producing chloride of carbon from bisulphide of carbon by means of iodine and chlorine has been described by me in the *Chemical Society's Journal* for 1862, p. 42, when I first published a short notice of a new method of effecting the substitution of chlorine for hydrogen in organic compounds.

In the meantime, this method for producing chlorinated compounds has received numerous applications, and has been frequently alluded to in the chemical journals. It will therefore be seen that the process patented by Mr. Charles Crump is not based upon a new chemical principle.

I am, &c. Hugo Müller.

Spurious Sulphate of Copper.

To the Editor of the Chemical News.

Sir,—I send you the analysis of a spurious sample of sulphate of copper which has lately made its appearance in commerce, and is said to be of continental manufacture. Its colour is much paler than usual, the tint being pure light azure without a shade of green:—

Sulphate of copper	21·7
Sulphate of iron	29·2
Sulphate of manganese	trace
Sulphate of zinc	47·9
Extraneous water and loss	1·2
	100·0

The salt consists, therefore, of a definitely crystallised mixture of the three vitriols, assumed to contain respectively the usual amounts of combined water.

I am, &c.,

John Spiller.

October 6.

MISCELLANEOUS.

The Sanitary Condition of the City of London—Extracts from the report of Dr. Letheby:—During the six weeks ending September 8, the common lodging-houses and nearly all the poorer classes of houses in the City, amounting to about 3000 in number, have been disinfected with chloride of lime, each from three to seven times; and in the performance of this work as much as seven tons of chloride of lime and half a ton of carbolate of lime have been used. And with the view of destroying the filth upon the surface walls which form the entrances to the courts and alleys of the City, a staff of from 12 to 50 workmen have been daily occupied in lime-whiting 147 of the public courts, which are all that required it. Besides which, a staff of men has been engaged every night in cleansing, and flushing, and disinfecting 184 courts, which required it. The streets, also, have been constantly watered with a solution of carbolic acid. In the performance of these cleansing and disinfecting operations, a staff of from 44 to 90 men have been daily engaged, in addition to the regular staff of inspectors; and besides the 7½ tons of disinfecting powder already alluded to, there have been used about 1000 gallons of carbolic acid.

Composition and Quality of the Metropolitan Waters in September, 1866.—The following are the Returns of the Metropolitan Association of Medical Officers of Health:—

Names of Water Companies.	Total solid matter per gallon.	Loss by ignition.*	Oxidisable organic matter.†	Hardness.	
				Before boiling.	After boiling
Thames Water Companies.	Grains.	Grns.	Grains.	Degs.	Degs.
Grand Junction	19·33	0·76	0·68	13·0	4·5
West Middlesex	15·89	0·84	0·80	14·5	4·5
Southwark & Vauxhall	17·83	0·91	0·72	13·0	4·0
Chelsea	19·00	0·85	0·56	13·0	4·5
Lambeth	18·54	1·00	0·79	13 5	4·0
Other Companies.					
Kent	25·89	1·01	0·28	18·0	7·5
New River	16·38	0·98	0·21	13·5	3·5
East London	18·52	1·00	0·39	14·0	5·0

* The loss by ignition represents a variety of volatile matters, as well as organic matter, as ammoniacal salts, moisture, and the volatile constituents of nitrates and nitrites.

† The oxidisable organic matter is determined by a standard solution of permanganate of potash, the available oxygen of which is to the organic matter as 1 : 8; and the results are controlled by the examination of the colour of the water when seen through a glass tube two feet in length and two inches in diameter.

H. Letheby.

The quality of the water supplied to the metropolis during the month of September has not differed very materially from that of the preceding month, the quantity of organic matter in the water derived from the Thames having been from 0·56 of a grain per imperial gallon to 0·80; while that in the East London, the Kent, and the New River supplies, which are obtained from other sources than the Thames, has ranged from 0·21 to 0·39 of a grain per gallon. In all cases the water has been perfectly bright and free from sedimentary matter.

Platinum Apparatus.—In our last number, mention was made of a platinised copper apparatus, which it was expected would prove serviceable in the laboratory. It may be of service if we mention that Messrs. Johnson and Matthey, the well-known platinum smiths of Hatton-garden, have been for the last twenty years in the habit of making and supplying vessels of platinised copper. They are certainly cleaner and less destructible than copper, but we understand they are not so economical as platinum vessels, as they quickly get injured by acid fumes and splashes, and then wear out. This firm exhibited platinised copper in the Exhibition of 1851, and at Paris in 1855. A large platinised copper bowl was likewise exhibited by them at the *soirées* of the Nottingham Meeting of the British Association. Messrs. Johnson and Matthey also contributed to this meeting other metallic specimens of great interest and value, the platinum alone being worth about 4000*l*. Amongst other things, one ingot of platinum attracted great attention; it was a thick slab of the metal made in one forging, and weighing more than 1000 ounces. It created some little amusement by the discrepancy which appeared to exist between its size and weight. Towering above this was a platinum boiler for sulphuric acid, weighing nearly 2000 ounces, in which many improvements were introduced, especially in the siphon arrangements. A very beautiful and complete series of preparations of the rarer platinum metals also deserved attention. These included melted ingots of pure iridium, pure rhodium, alloy of platinum and iridium, and melted

ingots of platinum. We must also draw attention to one novelty of especial interest, which this firm has lately brought out—that is, the patent gun vents of platinum. One of these, exhibited at Nottingham, had fired 2500 rounds without being in any way injured or affected.

The Gun-Cotton Explosion at Woolwich. — We lately devoted some space to the consideration of the gun-cotton question, the aspect of which seemed to justify hopeful anticipations of its satisfactory and not very remote solution. It may therefore be well that we should say a few words as to the bearing of the recent explosion at Woolwich upon the prospects of gun-cotton. This is important, because if gun-cotton be really liable, as might appear from the accounts of the occurrence, to explode spontaneously when carefully stored away in a magazine, it is evidently utterly worthless for practical purposes. But if it be not so liable—if it can be shown that the explosion was the direct result of artificial and abnormal conditions of storage experimentally applied—then the occurrence cannot really or permanently discredit gun-cotton, however it may temporarily prejudice the minds of those who do not care to inquire into the circumstances. In concluding our article on gun-cotton, and after enumerating the advantages which it presents, we said: "Against these advantages are to be urged only, that gun-cotton explodes at a very much lower temperature than gunpowder, and that it undergoes chemical change at an even lower temperature. These objections, which, if the difficulty of regulating the explosions be necessarily overcome, will alone remain, are fairly met by the arguments that the temperature requisite to explode gun-cotton (about 270°) is as purely artificial as that at which gunpowder explodes, and that as the substance will not decompose unless it is exposed to a temperature of about 130° continuously for a lengthened period, such a condition is practically artificial also, and could always be avoided." Now, the gun-cotton which exploded recently at Woolwich was the subject of an experiment at the hands of the Gun-cotton Committee, to determine for how long a period the substance would stand a high temperature without undergoing chemical change. For this purpose it was placed, not, as has been represented, in a bombproof store, but in a brick chamber specially constructed for the experiment, and provided with suitable apparatus for raising the temperature. For three months this chamber was heated daily for twelve hours to 120° Fahrenheit, and for seven months the temperature had been similarly raised to 130°. The gun-cotton was packed in large cases, to which registering thermometers were attached, with a view to noting any rise in the temperature of the cotton such as previous laboratory experiments had shown invariably precedes the decomposition of the cotton. A man was employed to register the periodical readings of the thermometer. Without going into the minuter details of the experiment, it may be stated that none of the cotton, although in each case was purposely deposited a less perfectly prepared sample, showed any signs of yielding to this artificial temperature for the first six months, when indications of incipient decomposition appeared in one case, which was promptly removed. Subsequently, from time to time, the thermometers of other cases rose, pointing to the commencement of chemical change in their contents, and necessitating, of course, the removal of the cases. If decomposition was thus invariably preceded by a rise in the temperature of the cotton, and if this rise were carefully noted, thus rendering it practicable to arrest any chemical disturbance by the immediate removal of the cotton, the experiment, it was argued, might safely be continued until the maximum period for which good gun-cotton would endure great heat had been satisfactorily established. The experiment was accordingly pursued until abruptly brought to a close by the explosion of the remaining gun-cotton after ten months' exposure in the hot chamber. Four possible explanations of the explosion suggest themselves:—1st. That the man whose duty it was to examine the thermometers, and who performed that duty only fifteen minutes before the explosion, failed to note the readings of *all* the thermometers; 2nd. That he noted one of the readings incorrectly; 3rd. That heat had been locally developed in the interior of a mass of cotton at such a distance from the thermometer as not to be sensible in a general rise of temperature; 4th. That, contrary to all precedent, a violent action suddenly occurred, without any previous rise of temperature. Whichever of these explanations be adopted, it is evident that no discredit is thrown upon the cotton itself, which has been placed under conditions specially contrived with a view to its destruction, though fenced about with such precautions as there were good grounds for supposing might be depended upon to insure the destructive action being noticed at its outset and stopped short of an explosion. On the other hand, the experiment had proceeded long enough to demonstrate that gun-cotton will sustain a more than tropical temperature for a much greater length of time than would occur in actual practice.—*Pall-mall Gazette.*

[We understand that between 140 and 150 lbs. of gun-cotton were being heated when the explosion took place.]

A Hint to London Shopkeepers.—A Paris tradesman announces that a five franc gold piece is secreted in one of every hundred sausages exposed for sale in his shop. The demand for sausages is something extraordinary. A perfumer having adopted a similar mode of increasing the sale of soap, was threatened by the sausage maker with legal proceedings for imitating his invention, but he soon ascertained that he had no ground of action. —*Building News.*

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. XIII. of the Chemical News, containing a copious Index, is now ready, price 11s. 6d., by post, 11s. 6d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I., II., and VII. are out of print. All the others are kept in stock. Vol. XIV. commenced on July 6, and will be complete in 26 numbers.

W. S.—The compressed gun-cotton is not prepared as an article of commerce.

A. F. W.—The use of perchloride of iron to deodorise the London sewage was proposed in 1860, but is attended with serious objections.

W. Johnstone.—Böttger has recommended gun cotton as a filter for strong acids and other liquids decomposable by organic matter. Filter your permanganate through a tuft of it.

F. M.—We have heard of oxygen being used for the purpose of more rapidly awakening patients from the influence of chloroform, but cannot say with what success.

J. Sutherland.—Received with thanks. The article shall appear next week.

F. S. Johnstone.—Dr. Hassall has written a very good treatise on the adulterations of food. We believe a new edition is in preparation. You will find a good account of the method of detecting the organic impurity in water by means of a permanganate in the Chemical News for December 6, 1862.

A Subscriber.—We are sorry we are unable to inform our correspondent where he can obtain a mixture of carbonate of soda and cocoa-nut oil. Neither do we know how it is manufactured, except by the simple process of mixing the ingredients together.

Clericus.—It is impossible to say, with any approach to accuracy, how much ammonia or tar products can be yielded by the distillation of a given weight of coal. A ton of coal is generally considered to yield about 20 gallons of tar, of which 1 gallon will be naphtha and 1 pint benzol.

A Forger.—We understand from a correspondent of the *Scientific American* that chilled iron can be softened by heating the iron red-hot, and exposing it for a few minutes to the flame of burning sulphur. If the iron has a flat surface, the sulphur can be placed upon it, when it will burn itself out, leaving the iron as soft as ordinary cast iron.

Books Received.—"Lecture Notes for Chemical Students," by Dr. E. Frankland, F.R.S.

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AND

Journal of Physical Science.

Edited by] [*Wm. Crookes, F.R.S.*

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Our readers must be well aware that chemical laboratories of almost palatial grandeur have for some time been in course of erection for the two important Prussian Universities of Bonn and Berlin. The design of the buildings, and the details of their arrangement, have been very wisely entrusted to Dr. Hofmann, and as a sum of money commensurate with the grandeur of the conception has been set apart for this purpose by the Prussian Government, there is little doubt that, as regards extent and completeness, these laboratories will be appointed in a manner unprecedented in the history of chemical education.

Early in January, a request was made by Her Majesty's Government to the Prussian Minister of Foreign Affairs for information on the general scope of the institutions, and on the objects contemplated; and an intimation of this wish of our Government to become more intimately acquainted with these great educational undertakings was accordingly conveyed to Dr. Hofmann.

We believe the information was principally required by the Science and Art Department, and almost at the same time that the diplomatic correspondence was going forward, Mr. Cole wrote to Dr. Hofmann, requesting that he would not only furnish full details of construction and arrangement of these laboratories, but would give information generally of the circumstances under which they were commenced, and the precise objects aimed at. We do not think it is premature to state that the noble precedent set by Prussia is likely to be followed by the establishment of a great chemical institution in our own metropolis; at all events, some such idea as this suggests itself in perusing the Report which Dr. Hofmann has drawn up at the request of the Committee of Council on Education. This comprehensive Report has been placed freely at our disposal by the author; we are also indebted to the great kindness of Henry Cole, Esq., C.B., for casts of all the elaborate wood engravings which contribute so materially to the clearness and completeness of this Report; and we shall accordingly place before our readers, with as little delay as possible, a full description of the chemical institution which is now fast approaching completion at the University of Bonn; and at a future time we hope to be enabled, through the courtesy of Dr. Hofmann, to furnish additional particulars respecting the interior fittings and working conveniences with which these palaces for chemical research will be so richly provided.

Gold Test.—A good test for gold or silver is a piece of lunar caustic, fixed with a pointed piece of wood. Slightly wet the metal to be tested, and rub it gently with the caustic. If gold or silver, the mark will be faint; but if an inferior metal, it will be quite black. Jewellers who purchase old gold often use this test.—*Am. Drug. Circ.*

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Part played by Chalk in Butyric and Lactic Fermentation, and the Living Organisms it contains, by M.* A. Bechamp.

During my study of fermentation, it occurred to me to inquire whether the only part played by chalk in the phenomena called butyric or lactic fermentation, is that of maintaining the neutrality of the medium—that is to say, of acting exclusively as carbonate of lime.

White chalk, which belongs to the upper part of the cretaceous stratum, seems to be formed, for the most part, from an extinct microscopic world. According to M. Ehrenberg, these fossil remains are of small organised beings of two families, which he names *Polythalamies* and *Nautilites*. These creatures, formerly organised, are so small and so numerous that a morsel weighing 100 grammes may contain 2,000,000 of them.

But independently of these extinct creatures, white chalk still contains a generation of organisms much more minute than any hitherto known, more minute than any of the infusoria or microphytes of fermentations; and they are not only present, but they are living and adult, though no doubt very old. They act with great energy as ferments (I purposely use this common phrase), and, in the present state of our knowledge, they are the most powerful I know, inasmuch as they are nourished on the most varied organic substances, as I will endeavour to show in a future memoir.

Take from the centre of a block of chalk, either recently taken from the quarry, or after it has been for some time extracted, a portion of the substance, no matter of what size (so that the results may not be supposed to be affected by atmospheric dusts); crush this, mix it with pure distilled water, and put under the microscope with the magnifying power of Nachet's No. 7 eyepiece No. 2 object-glass, and the field will be covered with brilliant points, often very numerous, shaken by a quick trembling movement.

It is generally said that they are animated by a *Brownian* movement. Not believing that this movement belonged to the molecules, and regarding them as living organisms, the smallest I had ever observed, I had recourse to two kinds of proofs to resolve the problem involved in this hypothesis. The first consists in showing these molecules to be ferments, the second in isolating and analysing them—that is to say, showing them to contain carbon, hydrogen, and nitrogen in the organic state.

I. Chalk without the addition of albuminoid matter acts as ferment. For all these experiments chalk from the centre of the block is used.

a. The Action of Chalk on Starch.—Mix thoroughly 420 grammes of starch paste containing 20 grammes of starch, 30 grammes of chalk from the centre of the block, and 4 drops of creosote. Prepare at the same time a similar mixture in which pure carbonate of lime, recently prepared and exposed for forty-eight hours to the action of the air, is substituted for chalk. The next day the two mixtures will appear to be in the same state. The day after, the mixture containing the chalk will begin to liquefy, and the following day will become perfectly liquid, whilst the other containing the carbonate of lime will not have changed. The soluble

* *Comptes Rendus*, lxiii., 451.

portions of the liquefied starch contain soluble fecula and traces of dextrine.

On November 14, 1864, 100 grammes of starch in the form of paste were placed in 1500 cubic centimetres of water, 100 grammes of Sens chalk, and 10 drops of creosote. The starch was found to liquefy as above, and soon carbonic acid and hydrogen were disengaged. On March 30, 1866, the product of the reaction was analysed, the result being—

Absolute alcohol . . .	4 c.c.
Butyric acid	8·0 gr.
Crystallised acetate of soda .	5·2 ,,

In another experiment, besides these products, a notable quantity of lactate of lime was obtained.

b. The Action of Chalk on Cane-sugar.—On April 25, 1865, 80 grammes of very white cane-sugar, 1400 grammes of chalk, and 1500 cubic centimetres of creosoted water were placed together. On June 14 the product was analysed with the following result—

Absolute alcohol . . .	2·6 c.c.
Butyric acid	4·5 gr.
Crystallised acetate of soda .	6·8 ,,
Crystallised lactate of lime .	9·0 ,,

I have verified these results, and found them always the same. I must add that, under the same conditions, pure carbonate of lime has no action, provided all contact with air be avoided; but there are cases in which creosote does not prevent these mixtures fermenting, which would make it appear that there are in the air adult organisms capable of existing in a creosotic medium containing lime.

I will add two observations: the first is, that, to prevent chalk from acting either on cane-sugar or starch, it should be moistened and heated to about 300°; the second is, that, if sufficient precautions be taken, there will be found, after fermentation, no other ferment than that observed in the chalk, though this will have augmented.

II. Chalk contains carbon, hydrogen, and nitrogen in the state of organic matter.—If the preceding experiments be really conclusive, organic matter ought to be found in chalk. To demonstrate this, I have submitted to organic analysis the insoluble part left by chalk when treated by dilute acids.

Dissolve an unpulverised block of chalk in weak hydrochloric acid. Collect the undissolved portions on strong and smooth paper, and wash them in acidulated water until no lime is detected in the filtrate. Then remove the moist residue with a card, without injuring the filter; spread it thinly on a sheet of glass, and let it dry screened from dust.

100 grammes of chalk will thus give 1·15 gr. of insoluble portions dried at 100°. By then drying at about 160°, and incinerating, it will be found that 100 parts of residue dried at 100° are formed of

	Per cent.
Water (lost at 100° to 160°) . .	2·47
Organic matter (lost by incineration).	7·17
Mineral matter (residue). . .	90·36
	100·00

Submitted to organic analysis, the residue dried at 100° furnished the following results:—

Carbon.	1·053
Hydrogen	0·740
Nitrogen	0·128

The nitrogen was estimated by Will and Varrentrapp's process. It was ascertained by a trial experiment that the sugar and soda lime employed produced no appreciable quantity of ammonia.

Is white chalk the only form of carbonate of lime which contains actually developed ferments? To resolve this question, I had recourse to M. Michel, who supplied me with a block of limestone of Pountil. This limestone behaved in exactly the same way as white chalk—in short, with chalk only (without any other albuminoid matter than that contained in the starch granules and the trace which may be supposed to exist in cane-sugar), cane-sugar and fecula starch may be fermented, and produce, besides alcohol, the characteristic limits of alcoholic fermentation, acetic, lactic, and butyric acids, the characteristic limits of lactic and butyric fermentations.

The name I propose for the small chalk ferments is "Microzyma cretæ." I believe this to be the first example of a class of organisms which I shall have the honour of laying before the Academy. The microzyma are to be found in many directions; they accompany various other ferments, they exist in certain mineral waters, in cultivated earth, where they no doubt play an important part, and I believe that a great number of molecules, considered as mineral, and animated by a Brownian movement, are no other than microzyma. Such are the deposits of old wines, of which I have treated in a former paper, and the deposits already described by Cagniard-Latour, and which he finally considered as inert matter.

TECHNICAL CHEMISTRY.

The Smoke Question, by Dr.* R. Angus Smith, *F.R.S.*

Warm interest has compelled me for many years to attend to the condition of the air of towns. Habit has no power of rendering smoke pleasant. Few men living in a smoky town require to be convinced that they are in the daily endurance of a monstrous evil. You do not require details, but it is well to remind you of some points, as possibly some present might have long ago given up all consideration of a sight which during all their lives had taken the appearance of an unavoidable misfortune. Many substances make their appearance as smoke from chimneys; that kind to be now considered is coal smoke; all other kinds are comparatively rare; and with us here smoke means generally coal smoke. There are various colours characteristic of smoke—from pale blue to grey, brown, and intense black. The first comes chiefly from domestic fires, when the heat is considerable, but the combustion slight. A dark grey or a deep brown smoke is a product of the distillation of coal. When the dense hydrocarbons have been heated highly, but with insufficient air, we have them decomposed, and carbon of a pure black is thrown out. The coloured substances in smoke are tar and carbon chiefly; the compounds vary with the heat, and may be numerous. Some time ago I calculated that 60 tons of carbonaceous matter were sent off in a day into the atmosphere in Manchester. A very small amount affects the atmosphere; a grain in 18 cubic feet is sufficient to convert good air into Manchester air, so far as carbon is concerned. About one half the colour is due to tarry matter, and the other half to black carbon only. This black matter is the colouring material of all our smoky towns, and, to a great extent, of the

* Read before the Social Science Congress, Manchester meeting, on the occasion of the discussion—"How far are smoke and the products of combustion arising from various manufacturing processes injurious to health?" "What measures ought to be taken to prevent the contamination of the atmosphere from such causes?"

clothes, as well as of the persons, of the inhabitants. We live in houses coloured by it, and we walk on roads coloured by it, and we can see the sun, the moon, and the heavens only after they have been, to our eyes, coloured by this universal tincture.

These are calamities of themselves; but, although some men would look on such a view of the case as mere sentiment, not one amongst us can fail to have his spirits tinged with the darkness of the sky. I found this strangely corroborated lately. One of the best men of business in Manchester informed me that, on an atmospherically dull day, no one would give a high price for goods, no one had the courage to give it, but on the other hand they could buy goods at a lower price—the seller had not the courage to hope for better.

These dull days are caused in part by the climate, but their remarkable oppressiveness is unquestionably due in great part to the smoke. We do not consider that by the smoke we make we are affecting our own spirits and clouding our own judgment. It is my belief that this effect on the spirits is the most powerful of all objections to smoke even in the minds of those who believe themselves above such feelings. There is, however, no denying the next great fact, that everything coming in contact with a smoky atmosphere is so blackened that cleaning becomes difficult or impossible. Smoke gives to every household it visits either a greater amount of labour or a lower social appearance. Let us suppose a housewife only strong enough to do all the work of her house so as to keep it comfortable when there is no smoke plague, she will break down before attaining the same results in a smoky town. We may, however, fairly doubt if it is possible by any means to attain the same results, and in reality they are not attained. We are apt to call the people who suffer most by it indolent, and they sometimes believe themselves so, but the cause is rather despair at the amount of work demanded of them. Even the higher wages in towns fail to make them reconciled to curtains blackening in a few days, when in country places these would have kept their windows neat for many months. Nor can the higher wages of town reconcile them to having their clothes blackened as soon as washed, instead of being dried when they are hung out for that purpose. The poor pay directly for the smoke, living where it prevails, and the middle classes and the wealthy suffer proportionately in being compelled to live out of the town, and to spend time in going to and fro. It is quite true that carbon, tar and sulphurous acids are disinfectants; but we do not wish to breathe them constantly—we cannot live on medicines. The disinfecting powers of smoke have not rid us of disease, nor does it prevent occasional pestilences. If it does good it does more evil, and much of the mortality of Manchester must be attributed to smoke. It has been said that if the carbon was thoroughly burned the amount of sulphurous acid would be so great as to be intolerable; but when the blackness is removed the sulphuric acid seems to escape more easily. We can imagine the carbon soaked with the acid, falling down with double effect upon the town.

One product of the combustion of any carbonaceous substance is carbonic acid; this is inevitable, and must be endured. Another product is carbonic oxide, which has a deadly character, is invisible, and is not sent out by the domestic fire, and only to a small extent by high chimneys. From a sanitary and economical, and an æsthetic point of view, we shall gain much by the removal of the carbon, and an additional gain will be obtained by removing the carbonic oxide. We are not, however, to suppose that all is then gained; we are not entirely safe until we have removed the sulphurous acid. To effect this is not a problem which we can expect to solve rapidly. The sulphur gases collect wherever there is any obstruction to ventilation. Sometimes the smoke is retained in the town as certainly as if a firmament were put over it of impenetrative material. On a still day, with a clear sky and considerable cold, the smoke lies on Manchester until the streets become dark at midday. It is then that the acids are found painful to the eyes, bad to the taste, dangerous to the breathing. The blackness might be removed; what shall we do with the sulphur?

It is the sulphur acids which render the air and rain of Manchester so destructive to metals. Iron roofs will not remain there; even houses cease rapidly to exist, and become old at an early period. The lime of the mortar becomes sulphate of lime, and the rain washes it away. The very stones decay under the constant action of acid, and the bricks crumble more rapidly. Even in places less troubled with smoke, we see the decay. The Parliament Houses, built to remain for ages, are rapidly, before our eyes, turning into plaster of Paris and Epsom salts. Probably some of the evil might be avoided. The finest buildings in London appear less handsome than flimsy structures in many Continental cities. With us, the peculiarity of the climate is a great enemy. On certain days, the acids rise rapidly; but, as a rule, they fall. Great extremes of dryness and of rain are the best protectives, and, during heavy showers, the air of Manchester is not unpleasant to breathe, because the sulphur is carried down in the rain. The coal used here contains not less than one per cent. of sulphur, and one of sulphur makes three of vitriol. Some coals contain more. The amount of sulphurous acid sent out is enormous—it cannot be less than 180 tons per day. The rain is acid. It falls on the living grass, and puts it out. Young plants struggle against it, but they cannot do so long. We scarcely know how much of the beautiful and useful is destroyed by this acid. The fine arts could scarcely flourish in an atmosphere which attacks without fear a great building which ought to remain sound for centuries.

One of the foremost printers of Lancashire told me that there were some colours which he found almost instantly to fade. They were frequently sent back upon his hands. He was annoyed to find that the French sent the same colours to the same markets without the risk of having them returned, and it was only after much time and loss that he found that the goods must not be allowed to pass through Manchester. One day was enough, but in some weather two hours were sufficient for their deterioration. The colours imbibed a poison and went off to die of it. He now sends such goods from his works without coming here, and he is as successful as his rivals in France.

It must be remembered that even if we burn smoke colourless, this sulphurous acid will remain. The rain will be equally acid, but if we burn the smoke no particles of carbon filled with vitriol will fall upon us. It will more readily diffuse. This seems to be the experience, but it is matter for open discussion. We are told on one side that the sulphurous acid is decomposed by the carbon, and that the sulphur falls down with it in a solid state. I do not know if this is a fact, but if it be, the result will be that the sulphur will be very finely divided, and in that state be oxidised by the air and water, forming oil of vitriol where it lies. It will not be less innocent, although it may change the sphere of its

iniquities. This may explain why the black vegetation is so frequently very acid, as it most surely is often or always found to be.

The only sure mode we know of diminishing the amount of acid given out by chimneys is by burning less sulphur. This can be done perhaps, to some extent, by burning less coal, and burning it more economically; next by not allowing the most sulphurous of the coals to be burnt in large towns. This latter is a simple mode of doing some good, and cannot in all cases be considered too great a demand on manufacturers. I inquired of engineers the amount of coal burnt per horse power per hour in the best and the most careless establishments, and was told that it varied from three pounds to fifteen pounds. I obtained other answers, which went lower and higher, but enough if we know that coal is, in many places, burnt at a wasteful rate. This is a department concerning which I am not called on to speak, but it comes as a part of my subject. If we examine this carefully, we shall find, in all probability, that the amount of heat we really use is trifling, whilst the coal is in amount enormous.

A wasteful management of coal is the perpetration of a nuisance not justified by the exigencies of manufactures, and the agents can scarcely plead that they are following a legitimate occupation. I shall say little of this; probably the change in this branch will be more gradual than the destruction of the blackness, but we must not forget it. A great thinker of the time said to me once, the nation reminds me of a man who was left a great barrel of wine for long use; he pulled out the bung to fill his little glass, and had not sense to see that the most of the liquid ran off on the floor. The diminution of the amount of coal burnt without giving out its equivalent of power, will be a benefit sanitary as well as economical. How far we have this in our hands, it is not easy to say; but it is so to some extent, and it would be well if the subject were kept before us permanently. People inform us that the selfishness and self-interest of manufacturers is sufficient for this. That is a theory which I never have found reason to believe in fully. The manufacturers are not more selfish than other men; and if they were, the most selfish man is often blind to his own interest.

One of the effects of the combustion of coal is to remove from the air a certain amount of oxygen, putting in its place the gases and carbonaceous substances spoken of along with coal ashes, which are in part carried upwards. The removal of the oxygen occurs only to a small extent, but it is perceptible, and in some cases considerable. This deterioration of the air occurs most in places where there is most carbon floating, and where it is therefore least pleasant to open our windows. Now, if there is less oxygen, we require the air to be renewed more frequently, and this we cannot permit because of the blackness. The smoke acts like a prison wall, and we shut windows and cease to ventilate. Bad as the air may be, it is better than that which we manufacture for ourselves by shutting our rooms, which remain closed until the bedrooms even in the large hotels of all our towns become unpleasant to the senses. It is the custom to ventilate by the doors from corridors only, in London and elsewhere, in hotels, lest the blacks should enter by the window, from which the freshest air comes. Private houses suffer equally. The weavers of Spitalfields were glad to be able to open their windows when the establishments near began to burn their black smoke, and this is a powerful argument against the opinion of those who would attempt to show that the sulphur is the only thing to be feared. Bad the sulphur gases unquestionably are, but it is the carbon which causes the alarm of housewives and housemaids, and which prevents the needful change of air in our town houses. The oxygen which is removed from the air is the whole of the most active portion. It has long been called ozone and peroxide of hydrogen; but, by whatever name, it is a something always found in agreeable air. This is never found in Manchester.

It is for medical men to consider what class of diseases may arise from this diminution of oxygen. Children suffer most in smoky towns, we are told. They have rapid circulation, they require much oxygen, and are instinctively fond of fresh air. It seems to me that the analyses of the air, showing a diminution of oxygen, even forgetting the sulphurous acid, explains why children should suffer so much, and helps, along with other causes, to explain what Mr. Leigh has called "the massacre of the innocents." The deficiency of active oxidation is equal to a deficiency of power and of healthy stimulus. If so, we need not wonder that some persons should seek artificial means of stimulus, nor why others should rather seek the less vigorous oxidation of a town. I cannot doubt that we have here some of the reasons for a deterioration of race spoken of by Dr. Morgan as visible amongst us. Our strength must be proportionate to the amount of healthy oxidation. If by any method we reduce the amount of floating blackness, we shall increase the purity of the air of the town, increase the beauty of its buildings, and improve the appearance of the inhabitants. We shall enable the houses to be ventilated more thoroughly, and we shall diminish the intensity of those days of darkness that sometimes paralyse the whole community. Every day will be brighter and, I think, happier to every inhabitant. If we diminish the sulphur by burning less coal, we shall diminish the amount of coal dust also, and these two points are not to be forgotten, although the full combustion requires first to be settled.

I will not speak of the means of burning smoke, which some years ago numbered twelve dozen. Amid the many conflicting opinions that are entertained, we cannot do better than trust to the great laws of nature we have learnt, which teach that smoke can be made colourless, and that the escaping of unburnt matter is a loss to the community. I do not entertain the extravagant hope that we may suddenly remove all the smoke of the country. We shall not succeed in our efforts if all our sympathy is on the side of the non-manufacturing public. Manufacturers often make efforts for the purification of the atmosphere greater than even the public have thought proper to require. It cannot be to the advantage of the country to oppress them; but it will be a great boon if they are compelled to work to a standard. It is felt to be an oppression when different rules are enforced in different places. The standard might probably begin low, and rise from year to year. It would be a cause of great gratification if the movement began with an association of manufacturers. If they have no inclination, they may perhaps seek the aid of the authorities, or if this is not done the authorities would no doubt receive from them assistance if it was required. At any rate, it would be well to see the manufacturers, the chief agents in making the reform. Municipal bodies have failed to produce any important reform. We must remember that we cannot live without rendering the air impure, and rich as the country may be, we cannot afford to destroy our manufactures in order to preserve the beauty of a few fields. In most cases there must be compromise. We should oftener

arrive at the truth if these questions were considered from wider points of view than are permitted in courts of law.

Process for the Estimation of Resin in Soaps, by J. SUTHERLAND.

HAVING often had occasion to analyse samples of soap, the author has found the great want of a process for the correct estimation of the resinous acids contained in admixture with the fatty acids. A process has been given in which spirit of turpentine is recommended for this purpose, but resin being so soluble in that menstruum, it is at once apparent that a correct result cannot be obtained. The following process depends on the fact that resin, when subjected to the action of nitric acid at 212°, is converted into a soluble substance known as terebic acid ($C_7H_{10}O_4$) with liberation of nitrous acid; while fatty acids are unacted upon, or at least inappreciably so. Of course, the oleic acid present is converted into claidic acid; but, as these acids are isomeric, the reaction does not interfere with the accuracy of the result obtained.

300 grains of the soap cut into small pieces are placed in a capsule and covered with strong hydrochloric acid, the capsule being covered with a piece of glass, and the contents kept gently boiling till the soap is dissolved and thoroughly decomposed. Three or four ounces of hot water are then added, and the capsule is set aside to cool.

When cold, the cake of fatty and resinous acids is carefully removed and re-melted on pure water to remove any acid solution adhering. After cooling it is dried on bibulous paper, and again very gently re-melted and carefully brought to the boiling point for a minute or two to expel the last traces of moisture.

This cake containing the fatty and resinous acids must now be weighed, and the weight carefully noted.

100 grains of the mixed acids are placed in a six or eight ounce capsule. It is covered with strong nitric acid, and the temperature gradually raised to the boiling point, when a powerful action takes place with violent evolution of nitrous acid fumes. The heat is withdrawn till the violence of the action subsides, and is then again applied to maintain gentle ebullition for some minutes, with frequent stirring.

Small portions of nitric acid are successively added till no further distinctly appreciable quantity of nitrous acid is given off. The fatty acids are now allowed to cool, and are carefully removed from the strongly acid and richly coloured solution of terebic acid. The cake is then washed by melting in a further quantity of nitric acid. When cold, it is dried and re-melted at a gentle heat till acid fumes cease to be given off.

The resulting cake is the pure fatty acid freed from resin, the latter being, of course, indicated by the loss. The author has found the above process to give most perfect results by subjecting soaps of known composition to its action.

It will be observed that a correction must be made to obtain the exact relative proportions of fat and resin originally put into the soap pan, as fats on being decomposed lose about 4½ per cent. of their original weight—*i.e.*, 100 parts tallow − glycerine = 95½ parts fatty acid. Hence, in making our calculation, a proportionate addition must be made to the fatty acid before dividing its weight by that of the resin indicated. This process is also applicable to the estimation of resin as an adulterant of beeswax.

Soap Works, Sydney Street, Glasgow.

PHARMACY, TOXICOLOGY, &c.

The Exhibition of the Pharmaceutical Conference, Nottingham.

(Concluded from page 173.)

AMONGST the remaining articles which deserve special attention we must mention those exhibited by Messrs. Savory and Moore, which included specimens of cigars, cigarettes, and cut *Datura Tatura*; medicated gelatine discs, narcotine, Ellis's anæsthetic fluids, Liebig's food for infants, and various pancreatic preparations. The latter deserve a more detailed notice. Their pancreatic emulsion is now an article of large consumption; it is a preparation beautiful to look at, and pleasant to eat, and seems to keep good for any length of time. The fat is first of all treated with the fresh pancreas, and is then extracted with ether. On distilling the ether off, the fat is left behind to all appearance unchanged. But it now possesses the power of mixing with water by means of a spoon, as easily as cream. What the change is that the pancreatic secretion produces in fat is not yet known; it is not saponification, for the fat globules in the emulsion, though very minute, are clearly distinguishable. There appears to be no doubt of the great efficacy of pancreatic emulsion in consumption and cases of extreme weakness of the digestive organs.

Messrs. T. and H. Smith exhibited thebolactate of morphia; gallic acid, nearly colourless; tannin, readily and perfectly soluble; aloin, crystalline tuft of the cathartic principle of aloes; and aconite sugar or mannite.

Messrs. Southall, Son, and Dymond, of Birmingham, forwarded two cases containing sixteen samples of opium and nine samples of scammony, with the following analysis of their most important constituents:—These specimens were selected as ordinary commercial samples such as are commonly met with in the English market. The object in making the analysis was to ascertain the relation which the market prices usually bear to the real values of opium and scammony as shown by the proportions of morphia, etc., and pure resin. The result shows that pharmaceutical preparations, made from these important drugs, are liable to serious variations of strength, unless the drugs employed are uniform in their important constituents, and that the market prices are no guide to the real value of these articles.

Analysis of Samples of Opium.

No.	Crude Morphia.	Dry Extractive.	Moisture.	Market Price.
1	7·5 p. c.	60 p. c.	14 p. c.	12/6
2	6·6	50	20	12/9
3	4	41	20	13/
4	8	30	24	13/
5	5	47	16	13/6
6	7·6	48	21	13/6
7	5·2	44	14	13/9
8	none	34	14	14/
9	11·5	48	18	14/6
10	11	44	18	15/
11	13·3	46	15	15/
12	10·5	50	18	15/
13	10·6	46	23	15/6
14	8·5	48	16	15/6
15	9·7	46	24	15/6
16	7	52	18	16

Analysis of Samples of Scammony.

No.	Pure Resin.	Market Price.	No.	Pure Resin.	Market Price.
1	18 p. c.	8/	†6	100	26/
2	14	12/	7	68	31/
3	29	15/	8	80	37/
4	36	18/	9	76	48/
*5	100	26/			

*M'Andrew's patent. †Made according to the British Pharmacopœia.

This firm also exhibited specimens of some of their iodine and bromine preparations—viz., iodide of ammonium, iodide of potassium, both crude, fused, and crystallised, bromide of ammonium and bromide of potassium.

From Mr. John Tuck was contributed a highly interesting series, consisting of samples of adulteration, &c., placed at his service by the Hon. Board of Inland Revenue. 1. "*Original Indian Essence*," consisting of methylated spirit of a strength of 70·1 under proof and treacle. 2. "*Indian Tincture*," consisting of methylated sweet nitre and treacle. 3. "The only original highly medicated and cordialised *Indian Brandee*," consisting of treacle and methylated spirit of a strength of 47·3 under proof. 4. "*Indian Brandee*," consisting of methylated spirit, hyponitrous ether, and treacle. These four samples were sold as medicines under the quoted names, but such compounds are in reality manufactured to be sold for beverages, and extensively used for this purpose in Lancashire and Yorkshire. The presence of methylated spirit in these compounds is clearly shown both by the iodo-hydrargyride of potassium and oxidation tests, as detailed in a paper read at the Birmingham meeting of the British Pharmaceutical Conference. 5. "*Whiskee*," containing methylated spirit of a strength of 60·0 under proof. 6. "*Essence of Ginger*," containing methylated spirit. These two samples were taken from a large quantity of spirits sold by public auction in Dublin, and when found to contain methylated spirit were seized by the Inland Revenue authorities. 7 and 21. *Glucose*, consisting of starch, sugar, and gum, and extensively employed in the manufacture of confectionery, and for the adulteration of jams and marmalade. It comes chiefly from France, and is made from potato- or wheat-starch. 8 and 9. *Concentrated ale and porter wort*, manufactured by the Concentrated Wort Company of Margate, to which has been given the name of "Grainstone." This concentrated wort is made of malt and hops in the ordinary way, and reduced by a patent process to a solid hard substance. To convert this substance into beer, porter, ale, or stout, more or less water has to be added, according to the strength required, and, when thus liquefied, it is fermented and racked off into casks in exactly the same way as ordinary beer is brewed. The "grainstone" is exported in the solid state in square tin cases, so that the heavy cost of the carriage of the water in ordinary beer is thus avoided; and, being hermetically sealed up, it will keep good without deteriorating or losing any of its qualities for years. Two pounds of this grainstone to every gallon of water makes a good beer. 10. *Adulterant for porter*, consisting of treacle extracted from sugar-bags and refuse of sugar refineries. There is reason to believe that this species of adulteration is practised a good deal both in London and in the country. 11. *Beer adulterant*, consisting of spent hops, which contain a large proportion of grains of Paradise. 12. *Beer adulterant*, consisting of ground capsicum, starch, and sugar. This was discovered at Stockton-on-Tees. 13. *Cavendish tobacco* of foreign manufacture, adulterated with liquorice. This is found chiefly in seaport towns, and consumed principally by sailors. 14. *Roll tobacco*, adulterated with cabbage leaf. This sample was purchased in Glasgow. 15. *Tobacco leaf* in process of manufacture, adulterated with 19 per cent. of sugar. This was seized in a manufactory at Newcastle-on-Tyne. 16. *High-dried* or *Irish Snuff*, containing upwards of 20 per cent. of caustic lime. This was obtained from Belfast. 17. "*Snuff*," coarsely ground, containing 2 per cent. of rhubarb leaf. The bulk of this snuff weighed several tons. Snuff is most extensively adulterated, and the following are some of the vegetable materials that have been used for this vile purpose, and seized by the Excise authorities:—Rhubarb leaves in several cases, acorns, dock leaves, sawdust, spent dyewoods, rhubarb, and coltsfoot leaves, the "combings" of malt, rhubarb, and potato leaves, coltsfoot and other plants, British tea leaves, &c. These adulterants are principally detected by the microscope. Amongst the mineral adulterants, the most injurious to health are the salts of lead, and if some of the others, such as salt, red ochre, chalk, lime, silica, &c., are not so injurious, they nevertheless defraud the revenue of considerable sums annually. 18. *Hamburg wine*, a sophisticated wine made to imitate sherry, and at one time extensively imported from Hamburg and other German ports. This fraudulent practice is now, however, much checked. 19. *Cadiz sherry wine* of low quality, containing 50 per cent. of proof spirit, used for the fortification of wine to suit the English markets. 20. *Methylated spirit* purified from oil by a process patented by Mr. J. Watson Barton, of Leeds.

Dr. Wagner, Pest, Hungary, forwarded for exhibition a very interesting series, amongst which we noticed chemical works for pharmaceutico- and technico-chemical preparations, simple and compound medicines, essential oils and essences for the manufacture of wines, liqueurs, and brandies; assortment of objects of pharmacy; drugs and minerals, and utensils for photography. *Cognac oil*, distilled from the most selected Hungarian wine lees; these are very convenient for use, and produce at a moment's notice cognac brandy, retaining the flavour of the wine. Cognac oils are used also for manufacturing artificial wines, and for the amelioration of inferior descriptions. *Tellurium metal*, only manufactured in this establishment. The tellurium ore comes from Nagyag, Transylvania, with silver and gold, as Tellurblätterer.

Messrs. John Gillon and Co., of Leith, showed a case containing preserved meats, including beef, mutton, chicken, and other dietetic preparations. Concentrated meat lozenges and extractum carnis are in this series.

Mr. Hadlow exhibited his very excellent and novel boxwood linen markers, with ink and specimens of work.

PROCEEDINGS OF SOCIETIES.

BRITISH ASSOCIATION, NOTTINGHAM MEETING.

Friday, August 24.

A Lecture "On the Results of Spectrum Analysis, as applied to the Heavenly Bodies," by William Huggins, *F.R.S.*

(*Continued from page* 175.)

MOON AND PLANETS.

I now pass to the results of our observations.

I refer in a few words only to the moon and planets. These objects, unlike the stars and nebulæ, are not original sources of light. Since they shine by reflecting the sun's light, their spectra resemble the solar spectrum, and the only indications in their spectra, which may become sources of knowledge to us, are confined to any modifications which the solar light may have suffered either in the atmospheres of the planets, or by reflection at their surfaces.

Moon.—On the moon the results of our observations have been negative. The spectra of the various parts of the moon's surface, when examined under different conditions of illumination, showed no indication of an atmo-

sphere about the moon. I also watched the spectrum of a star, as the dark edge of the moon advanced towards the star, and then occulted it. No signs of a lunar atmosphere presented themselves.

Jupiter.—In the spectrum of Jupiter, lines are seen which indicate the existence of an absorptive atmosphere about this planet. In this diagram these lines are presented as they appeared when viewed simultaneously with the spectrum of the sky, which at the time of observation reflected the light of the setting sun. One strong band corresponds with some terrestrial atmospheric lines, and probably indicates the presence of vapours similar to those which are about the earth. Another band has no counterpart amongst the lines of absorption of our atmosphere, and tells us of some gas or vapour which does not exist in the earth's atmosphere.

Saturn.—The spectrum of Saturn is feeble, but lines similar to those which distinguish the spectrum of Jupiter were detected. These lines are less strongly marked in the ansæ of the rings, and show that the absorptive power of the atmosphere about the rings is less than that of the atmosphere which surrounds the ball. A distinguished foreigner present at the meeting, Janssen, has quite recently found that several of the atmospheric lines are produced by aqueous vapour. It appears to be very probable that aqueous vapour exists in the atmospheres of Jupiter and Saturn.

Mars.—On one occasion some remarkable groups of lines were seen in the more refrangible part of the spectrum of Mars. These may be connected with the red colour which distinguishes this planet.

Venus.—Though the spectrum of Venus is brilliant and the lines of Fraünhofer are well seen, no additional lines affording evidence of an atmosphere about Venus were detected. The absence of lines may be due to the circumstance that the light is probably reflected, not from the planetary surface, but from clouds at some elevation above it. The light which reaches us in this way by reflection from clouds would not have been exposed to the absorbent action of the lunar, and denser strata of the planet's atmosphere.

THE FIXED STARS.

The fixed stars, though immensely more remote, and less conspicuous in brightness than the moon and planets, yet because they are original sources of light, furnish us with fuller indications of their nature.

To each succeeding age the stars have been a beauty and a mystery. Not only children, but the most thoughtful of men often repeat the sentiment expressed in the well-known lines—

> "Twinkle, twinkle, pretty star!
> How I wonder what you are!"

The telescope was appealed to in vain, for in the largest instruments the stars remain diskless, brilliant points merely.

The stars have indeed been represented as suns, each upholding a dependent family of planets. This opinion rested upon a possible analogy alone. It was not more than a speculation. We possessed no certain knowledge from observation of the true nature of those remote points of light. This long and earnestly coveted information is at last furnished by spectrum analysis. We are now able to read in the light of each star some indications of its nature. Since I have not a magician's power to convert this theatre into an observatory, and so exhibit to you the spectra of the stars themselves, I have provided photographs of careful drawings. These photographs Mr. Ladd will exhibit upon the screen by means of the electric lamp. I will take first the spectra of two bright stars which we have examined with great care.

The upper one represents the spectrum of Aldebaran, and the other that of Betelgeux, the star marked α in the constellation of Orion.

The positions of all these dark lines, about 80 in each star, were determined by careful and repeated measures. These measured lines form but a small part of the numerous fine lines which may be seen in the spectra of these stars.

Beneath the spectrum of each star are represented the bright lines of the metals which have been compared with it. These terrestrial spectra appeared in the instrument as you now see them upon the screen, in juxtaposition with the spectrum of the star. By such an arrangement, it is possible to determine with great accuracy whether or not any of these bright lines actually coincide with any of the dark ones. For example:—

This closely double line is characteristic of sodium. You see that it coincides, line for line, with a dark line similarly double in the star. The vapour of sodium is therefore present in the atmosphere of the star, and sodium forms one of the elements of the matter of this brilliant but remote star.

These three lines in the green are produced, so far as we know, by the luminous vapour of magnesium alone. These lines agree in position exactly, line for line, with three dark stellar lines. The conclusion therefore appears well founded that another of the constituents of this star is magnesium.

Again, there are two strong lines peculiar to the element hydrogen; one line has its place in the red part of the spectrum, the other at the blue limit of the green. Both of these correspond to dark lines of absorption in the spectrum of the star. Hydrogen therefore is present in the star.

In a similar way, other elements, among them bismuth, antimony, tellurium, and mercury, have been shown to exist in the star.

Now, in reference to all those elements, the evidence does not rest upon the coincidence of one line, which would be worth but little, but upon the coincidence of a group of two, three, or four lines, occurring in different parts of the spectrum. Other corresponding lines are probably also present, but the faintness of the star's light limited our comparisons to the stronger lines of each element.

What elements do the numerous other lines in the star represent? Some of them are probably due to the vapours of other terrestrial elements which we have not yet compared with these stars. But may not some of these lines be the signs of primary forms of matter unknown upon the earth? Elements new to us may here show themselves, which form large and important series of compounds, and therefore give a special character to the physical conditions of these remote systems.

In a similar manner the spectra of terrestrial substances have been compared with several other stars. The results are given in the diagrams. Five or six elements have been detected in Betelgeux. Ten other elements do not appear to have a place in the constitution of this star.

β *Pegasi*	contains	sodium, magnesium, and perhaps barium.
Sirius	,,	sodium, magnesium, iron and hydrogen.
α *Lyræ* (*Vega*)		sodium, magnesium, iron.
Pollux	,,	sodium, magnesium iron.

About sixty other stars have been examined, all of which appear to have some elements in common with the sun and earth, but the selective grouping of the elements in each star is probably peculiar and unique.

A few stars, however, stand out from the rest, and appear to be characterised by a peculiarity of great significance. These stars are represented by Betelgeux and β Pegasi. The general grouping of the lines of absorption in these stars is peculiar, but the remarkable and exceptional feature of their spectra is the absence of the two lines which indicate hydrogen, one line in the red, and the other in the green. These lines correspond to Fraünhofer's C and F. The absence of these lines in some stars shows that the lines C and F are not due to the aqueous vapour of our atmosphere.

We hardly venture to suggest that the planets, which may surround these suns, probably resemble them in not possessing the important element, hydrogen. To what forms of life could such planets be adapted? Worlds without water? A power of imagination like that possessed by Dante would be needed to people such planets with living creatures.

It is worthy of consideration that, with these few exceptions, the terrestrial elements which appear most widely diffused through the host of stars are precisely some of those which are essential to life, such as it exists upon the earth—namely, hydrogen, sodium, magnesium, and iron. Besides, hydrogen, sodium, and magnesium represent the ocean, which is an essential part of a world constituted like the earth.

We learn from these observations that in plan of structure the stars, or at least the brightest of them, resemble the sun. Their light, like that of the sun, enanates from intensely white-hot matter, and passes through an atmosphere of absorbent vapours. With this unity of general plan of structure, there exists a great diversity amongst the individual stars. Star differs from star in chemical constitution. May we not believe that the individual peculiarities of each star are essentially connected with the special purpose which it subserves, and with the living beings which may inhabit the planetary worlds by which it may possibly be surrounded?

When we had obtained this new information respecting the true nature of the stars, our attention was directed to the phenomena which specially distinguish some of the stars.

(To be continued.)

ACADEMY OF SCIENCES.

October 1.

(Concluded from page 175.)

"*On the Action of Magnesium on Neutral Metallic Salts*," by M. A. Commaille. The author finds that hydrogen is always evolved when a metal is precipitated by means of magnesium, and the precipitation is never complete. With ferrous sulphate, hydrated protoxide of iron is precipitated. In an acid solution metallic iron comes down. With mixed chromic and chromous chloride, hydrated sesquioxide of chromium is precipitated. With manganous sulphate, the reaction is the same as with iron. With cobalt sulphate, the reaction is very slow; after a few days the hydrated oxide, Co_3O_4, deposits on the magnesium. With nickel sulphate the precipitate formed is the hydrated protoxide. With oxalate of uranium a golden-coloured deposit of hydrated sesquioxide is produced—U_2O_3HO. With sulphate of zinc there is an energetic action, and the metal, the hydrated oxide, and sub-sulphate are precipitated. With chloride of cadmium the reaction is also very energetic, and a mixture of oxychloride of cadmium and metallic cadmium is precipitated. Bismuth salts being acid give a precipitate of pure metallic bismuth. Protochloride of tin gives spongy tin and stannic acid. The disengagement of gas is very strong with neutral chloride of lead; the deposit consists of lead mixed with oxychloride. Sulphate of copper gives, with magnesium, the metal, the hydrated protoxide, and a green subsalt. With chloride of copper no metal is precipitated, but a deposit of Brunswick green. With bichloride of mercury, calomel and binoxide of mercury are precipitated. With bichloride of platinum and chloride of gold the metal only is precipitated.

"*Analysis of the Waters of Vergèze; Microzyma and other Organisms found in this Water*," by M. A. Béchamp. These waters are remarkable as containing considerable quantities of acetic and butyric acids. Bunsen has already detected propionic acid in a German spring. Scherer has likewise found butyric, propionic, acetic, and formic acids in a Bavarian water. This is the first time that organic acids have been found in a French spring. Upon examining the deposit of this water under the microscope, a considerable number of mobile corpuscles were observed, similar to those seen in native chalk. The author supposes that these microzyma are the cause of the formation of the volatile fatty acids.

"*On the Synthesis of Resorcine*," by M. W. Korner. The author starts with benzol; converts this into binitrobenzol; from this prepares paranitroaniline; transforms the nitrate of this base into nitrate and then sulphate of paradiazonitrobenzol. Under the influence of hydriodic acid this salt gives paraiodonitrobenzol, which, with tin and hydrochloric acid, is reduced to paraiodaniline. From the nitrate of this base the sulphate of paradiazoiodobenzol is formed. This salt decomposed by boiling water gives a new acid, paraiodophenic acid. This is solid and well crystallised; its most remarkable property is to give, under the influence of fused potash, a crystallised combination which is the inferior homologue of orcine described by MM. Hlasiwitz and Barth under the name of resorcine. The author hopes to show that phloroglucine and pyrogallic acids are trihydroxylic derivatives of benzol, and that, by starting from toluol, he will effect the synthesis of orcine.

"*Sixth Memoir on Heliochromy*," by M. Niepce de Saint-Victor. The author has succeeded in preparing a plate of silver on which all the colours, and even white and black, are capable of being impressed in the camera. The paper contains several improvements in detail, principally with a view to obtain good blacks.

"*On the Development of Small Acari in Potatoes*," by M. Guérin-Mèneville.

"*On the Earthquake of the 14th September*, 1866," by M. Moll.

"*On the Conditions which influence the Development of Primitive Vaccine*," by M. A. Chauveau.

October 8.

Chemical science appears to have almost exhausted itself at the last sitting, and left little of interest for the present meeting. The first paper read was

"*On the Theory of Heat according to the Vibratory Hypothesis*," by M. Babinet. As might be imagined from the title, this was almost exclusively a mathematical paper. It was followed by some

"*Remarks, in reference to the preceding Communication, on Stahl's Explanation of Combustion*," by M. Chevreul.

"*On Animals which have disappeared from Martinique and Guadeloupe since our Establishment on these Islands*," by M. Guyon.

"*On Pluviometric Observations and their Importance in the Supply of Potable Water to Dense Populations*," by M. G. Gremaud de Caux. Leverrier wisely observed that rain is one of the meteorological phenomena which stand in the most direct relations with agriculture. The author calculates that, even in thickly-populated parts of rural districts, far more than sufficient rain falls to supply the wants of the inhabitants. But he considers that five litres daily is sufficient water for each person, and therefore his calculations, however suitable to France, will scarcely be adapted to our insular prejudices in favour of cold tubbing.

"*Researches on Isatine*," by Hugo Schiff. The author finds that the sulphites and bisulphites of certain bases possess the property of direct combination with aldehydes. By employing pure ether as a solvent for the sulphites and bisulphites, he has prepared acetyl-bisulphite of aniline, benzoyl-bisulphite of amylamine, and valeryl-bisulphite of amylamine; and with neutral sulphites, benzoyl-sulphite of aniline, œnanthyl-sulphite of aniline, valeryl-sulphite of aniline, and benzoyl-sulphite of toluidine. At a high temperature these bodies decompose, forming diamides. These compounds have as yet only been obtained with primary monamines. The sulphites of conline, of quino-

line, of ethylaniline, of toluylendiamide, and of rosaniline, do not combine with aldehydes. These reactions may serve as a test for aldehydes. Isatine will combine direct with alkaline bisulphites, forming analogous compounds; and following this out, the author has prepared isato-bisulphite of aniline,

$$SO_2,C_6H_7N,C_8H_5NO_2$$

and isato-bisulphite of amylamine,

$$SO_2,C_5H_{13}N,C_8H_5NO_2.$$

Similar compounds have been formed with toluidine and ethylamine, and in all cases white crystalline salts have been obtained, which possess the physical and chemical properties of the analogous derivatives of aldehydes. The author has also found that the diatomic residue C_8H_5NO of isatine can replace the typical hydrogen of organic bases in the same manner as the residues of aldehydes. By acting on isatine with amylamine and ethylaniline, the following compounds have been obtained:—

$$N_2\begin{cases}C_8H_5NO\\C_8H_5NO\\2C_5H_{11}\end{cases}$$

Amylisatimide.

$$N_2\begin{cases}C_8H_5NO\\2C_6H_5\\2C_2H_5\end{cases}$$

Ethylphenylisatimide.

These bodies crystallise difficultly in small yellow plates slightly soluble in ether and very soluble in alcohol; they are decomposed by acids and water. The author considers on these and other grounds that isatine, although a crystalline nitrogenous body, ought to be considered as a kind of aldehyde.

"*On Means of utilising the Phenomena of Supersaturation*," by M. Jeannel. The author suggests that this phenomenon may be utilised in the purification of certain salts. Thus, for the purification of commercial sulphate of soda, take 300 grammes of this salt and 100 grammes of distilled water; dissolve at a temperature of 33° in a glass flask; and while this is going on arrange a filter in a funnel, and pour through it 500 grammes of warm water at about 50°. Then place the funnel on a wide-mouthed flask well rinsed with distilled water, pour the warm saline solution on the filter, and cover it with a plate of glass. The solution will entirely pass through without crystallising, and will remain liquid in the flask even after cooling. When the funnel is removed, the solution, exposed to the air, rapidly crystallises and becomes heated. When quite cold, decant the mother liquor. Sulphate of magnesia, sulphate of zinc, and carbonate of soda may be purified in a similar manner. The acetate and tartrate of soda, soluble in their water of crystallisation at a temperature below 100°, may be easily filtered by this means. This process is not applicable to alum. The author proposes to use this phenomenon as a means of separating salts; thus, dissolve 335 grammes of nitre and 300 grammes of alum in 100 grammes of water; allow the mixture to cool without exposure to the air, and the nitre will crystallise out, whilst the alum will remain in a state of supersaturation. The separation of the two salts can thus be effected by decantation.

"*On Blue Slags*," by M. C. Méne. The blue colour of certain slags is generally considered to be due to the presence of titanic acid. The author gives nineteen analyses, in which he shows that titanic acid is not always the cause of the blue colour; it being the colouring matter when the slags are vitreous, but not when they are compact. The author's process for detecting titanic acid is as follows:—Pulverise and porphyrise 10 to 15 grammes of slag, and treat it with cold dilute sulphuric acid (1 to 10), so as to avoid all heating. The mass soon becomes gelatinous; add plenty of water, and agitate with a glass rod. Filter, wash the precipitate, and boil the filtrate for a quarter of an hour, when the liquid will gradually become opaque, as if hydrate of alumina were suspended in it, and a white precipitate gradually forms in the vessel. Filter, redissolve in sulphuric acid, wash, and again boil, and upon the resulting precipitate the characteristic reactions of titanic acid may be obtained. In the discussion on this paper, M. Chevreul considered that the blue coloration might sometimes be due to the presence of a particular oxide of iron.

"*Note on the Rotting of Fruits*," by MM. Letellier and Spineux.

"*On the Volcanic Phenomena of Santorin during the Month of August*," by M. de Cigalla.

NOTICES OF BOOKS.

Bibliothèque Universelle et Revue Suisse. Archives des Sciences Physiques et Naturelles. Nos. 103 and 104. July and August, 1866.

The first article in No. 103 is entitled

"*Researches on the Propagation of Electricity in Highly Rarified Elastic Fluids, and especially on the Stratifications of the Electric Light which accompany this Propagation*," by A. de la Rive. The author has introduced a novel method of research, which appears capable of throwing considerable light on these obscure phenomena. The following is a brief outline of the method of procedure:—The apparatus employed to study the propagation of electricity through metallic vapours consists of a large glass globe furnished with four tubulures, and standing on a foot. The two tubulures which are at the extremities of the horizontal diameter are furnished with leather stuffing boxes traversed with metallic rods. To the extremities of these are fixed the metallic or carbon points, between which are produced the voltaic arcs of a pile of 60 to 80 Bunsen's batteries. The two tubulures situated at the extremities of the vertical diameter are traversed by two brass rods, terminated by the metallic spheres, between which passes, at the same time, an electric current from a Ruhmkorff's coil of moderate power excited with one or two large-sized Grove's batteries. The globe is first well exhausted and then filled with nitrogen, which is then rarified to 2 or 3 milimetres pressure. The Ruhmkorff current is then turned on, and the intensity of it is measured by means described in the paper. The horizontal metallic points are then caused to approach so as to produce a voltaic arc, which here acts solely as a source of heat. In a few minutes the intensity of the Ruhmkorff's current augments considerably, and its colour alters according to the nature of the points between which the voltaic arc is formed. With points of silver and zinc the induction current is of a decided blue colour, deeper with zinc than with silver. With points of copper, cadmium, aluminium, and magnesium, the tint is green, very deep with copper, apple-green with cadmium, very clear green with magnesium, and greenish-white with aluminium. With points of retort carbon, the tint of the induced current is a clear blue, which changes to a greyish-blue when the arc ceases. It is in the upper part of the globe where the metallic vapours from the voltaic arc rise that the effect is best seen. The striæ or stratifications of the electric light are still better seen in these vapours than in rarified gases. With the arc taken between points of iron there is a change of colour in the induced current, and a slight augmentation of its intensity; with platinum nothing was obtained but a very little increase in the intensity of the jet, which might be caused by the action of the high temperature on the conductibility of the rarified nitrogen. The second part of the paper is devoted to a *study of the stratifications of the electric light*, which the author considers to be a phenomenon analogous to the production of sonorous waves—that is to say, a mechanical phenomenon arising from a succession of isochronous impulses exerted on the rarified gaseous column by a series of rapidly succeeding electric discharges. The third part is devoted to a discussion of *particular phenomena which different parts of the electric stratification present*. The author has already shown that the rarified gaseous column traversed

by the induction current is composed of alternate dilated and condensed layers with a dark and highly dilated space in the neighbourhood of the negative electrode. The most dilated parts of the column, offering less resistance to the passage of the current, should remain dark, whilst the more condensed parts, being worse conductors, should become superheated and luminous. The phenomenon would therefore be exactly analogous to that observed when a voltaic current of a certain strength is passed through a chain composed of alternate links of silver and platinum. The author proves in an ingenious manner that the dark spaces of the stratification conduct electricity better than the luminous portions. He also shows by thermometric observations that by the same reasoning which shows the worse conducting gaseous portion is more luminous than the better conducting portion, so the temperature of the former portion is more elevated than that of the second.

"*On the Glaciers of the Valley of Chamonix*," by M. C. Martius.

"*On Traces of Glacier Action in the Environs of Baveno*," by M. C. Martius.

No. 104 (August 25) contains very little likely to interest our readers. The articles are:—

"*Meteorological Résumé of the Year 1865 for Geneva and Great St. Bernard*," by Professor Plantamour.

"*On the Limits of the Jurassic and Cretaceous Period*," by M. Hebert.

"*Geological Chart of the Environs of Paris*," by M. E. Collomb.

"*Description of a Sounding Instrument to measure the Depth of Lakes*, by M. C. Martius. The author uses a line with a weight at the end, lets it run off a reel till the weight touches the bottom, and then measures the length of rope which has run out. The novelty of the plan is not very evident.

Among the extracts from foreign journals which this number contains are the following:—

"*On the Metals of the Tantalum Group*,"* by C. W. Blomstrand. The author admits the accuracy of Marignac's researches on niobium and the constitution of niobic and tantalic acid. The analytical methods followed by the Swedish chemist are more laborious and less direct than those of Marignac, and do not admit of such accuracy, although they fully confirm the results of the latter.

"*On the Combinations of Uranium with Fluorine*,"† by H. C. Bolton. The *protofluoride*, UFl_2, is an insoluble green powder slightly attacked by acids. *Fluoxyuranate of potassium*, $3KFl,2(UOFl)$ is formed by mixing nitrate of uranium with fluoride of potassium, and recrystallising the difficultly soluble precipitate. It is citron-yellow, and forms oblique rhomboidal prisms. It does not attack glass. Alcohol and ether do not dissolve it. 100 parts of water at 21° C dissolve 12·5 parts. The corresponding soda and ammonia salts appear very difficult to prepare. *Fluoxyuranate of barium*, $3BaFl_2,4(UO,Fl)+2aq.$ is a crystalline citron-yellow precipitate, soluble in weak acids. *Uranoso-potassic fluoride*, $KFl,2(UFl_2)$ is precipitated as a green insoluble powder when a solution of fluoxyuranate of potassium is mixed with formic acid and exposed to the sun. Fluoxyuranate of potash precipitates salts of barium, calcium, and lead, but has no action on salts of silver, copper, mercury, zinc, and platinum.

"*On Combinations of Magnesium with Calcium and Aluminium*,"‡ by F. Wöhler. An alloy of aluminium and magnesium is formed by fusing the two metals under a layer of common salt. Equal equivalents of the metals form a tin-white brittle mass, burning at a red heat, like magnesium. The alloy of calcium and aluminium is formed by heating equal weights of sodium and aluminium with a large excess of chloride of calcium. It is lead-grey and very lustrous, sp. gr. 2·57, and unalterable in water or air.

The other notices which are contained in these two numbers are of papers which have already been before our readers.

* *Memoirs of the University of Lund.*
† *Zeitschrift für Chimie.*
‡ *Annalen der Chem. und Pharm.*

Elementary Treatise on Physics, Experimental and Applied. Translated and edited from Ganot's "Éléments de Phyaique," by E. Atkinson, Ph.D., F.C.S., Professor of Experimental Science, Royal Military College, Sandhurst. Second edition, revised and enlarged. London: Baillière.

This is a new edition of a translation of a work which has been long and deservedly popular in France, and seems likely, through the labour of Mr. Atkinson, to become equally appreciated in this country. As stated in the preface, it is chiefly intended as a text-book for students, and for this purpose it is admirably adapted, giving the framework of the whole of the physical sciences; though of necessity much of the detail in any particular section must be acquired from more extensive works. The headings of the books will show the range of subjects which the treatise embraces; they are as follows:—I. Matter, Force, and Motion; II. Gravitation and Molecular Attraction; III. Liquids; IV. Gases; V. Acoustics; VI. Heat; VII. Light; VIII. Magnetism; IX. Frictional Electricity; X. Dynamical Electricity. At the end is also inserted a chapter entitled "Elementary Outlines of Meteorology and Climatology."

The fact that all this is contained in 800 pages necessarily implies much condensation and some omissions, and we think the author has acted wisely in confining himself almost entirely to the theoretical portions of these subjects, and especially to their mathematical developments. When once the principles of a science are well known, the practice of it will be easily understood and acquired; but the converse of this by no means holds good.

The first five books, comprising the mere mechanical properties of bodies, occupy only about one-fourth of the entire space, the rest being almost equally divided between light and heat on [the one hand, and magnetism and electricity on the other. The latest researches of Professor Tyndall on heat, and the separation of the obscure from the luminous rays, are given, and the subject of spectrum analysis is illustrated by coloured spectra of solar light, potassium, sodium, cæsium, and rubidium. The principles of photography are summed up in three pages, and the electric telegraph in eleven, but in treating of optics and the polarisation of light the author goes into more detail. The laws of electricity include almost all that are at present known; but we are sorry to find that several instruments of modern introduction are overlooked; thus, the original gold-leaf electroscope is the only one mentioned, and no account is given of Professor Sir William Thomson's reflecting mirror galvanometer, which has now come into very general use. We are glad, however, to see a short description and explanation of Wheatstone's electric bridge, which is too often omitted in works on electricity, although it is to that science what the balance is to chemistry, and, next to the battery and galvanometer, is perhaps the most important instrument the electrician possesses. In dynamical electricity is also given "Ohm's law" and its numerous applications; methods of testing the resistance of wires and the resistance and electromotive force of batteries; also tables of specific conductivity and the law of the changes of resistance caused by variations of temperature.

We can confidently recommend this work, and will conclude our notice by saying that the English, unlike that of many translations, is clear and vigorous and the printing good; the whole being illustrated by over 600 well-executed woodcuts.

NOTICES OF PATENTS.

300. *Improvements in Working and Treating India-rubber, Gutta Percha, and other similar Gums.* A communication from Frank Marquard, of Rahway, New Jersey, United States of America. Dated January 31, 1866.

The patentee directs that about two pounds of pure india-rubber or other similar gum be first taken and dissolved in about thirty-two pounds of chloroform; other solvents may be used, though chloroform is preferable. When the gum has been thoroughly dissolved in any properly constructed vessel, the solution is charged with a strong caustic ammonia gas, or treated with a preparation of chloride of ammonium, though he prefers the use of the caustic ammonia gas to bleach the rubber or other gum operated on. When the gum has been thoroughly bleached, which is ascertained by frequent inspection and testings, the charging with the gas or bleaching agent is suspended, and the solution is removed to a boiler or other suitable vessel having an agitator in it, and then subjected to a washing process with hot water until the gum is entirely freed from the bleaching agent used. This is effected by a constant agitation of the solution by keeping the agitator in motion in the washing vessel. At the same time that the washing process is going on, the degree of heat in the boiler may be increased to about 176° Fahrenheit to evaporate the chloroform from the gum, which by means of any proper arrangement of pipes may be led to a condensing vessel or chamber, where it may be collected to be used over again as a solvent for the gum. It will be obvious that the distilling operation may be carried on by a subsequent operation to the washing process, but whether carried on simultaneously with the washing process, or by a subsequent operation, the object is the same, to wit:—First, to free the gum from the chloroform at this stage of the process; and, second, to save the chloroform for subsequent use by collecting it in a condenser as it evaporates from the gum. The product thus obtained from the distillation of the gum is then in the form of a froth, which is strained or collected from the solution and then pressed and dried. It is then redissolved in a small quantity of chloroform to a consistency of a thick paste and mixed with finely prepared pure phosphate of lime, or carbonate of zinc, in such proportions as to give a body to it, and having the appearance of slightly dampened meal, in which condition it is subjected to pressure in hot moulds to give coherence to it and expel any excess of chloroform from it. With a sufficient degree of pressure this can be done at once, and the compound, after coming from the mould, may then be put in the lathe or other mechanism to be worked and shaped into all manner of forms and devices.

It will be obvious that the articles thus formed would be white, but to make articles to imitate coral, pearl, enamel, woods of various kinds, and other substances, it is only necessary to mix any of the various coloured dry pigments with the compound at the same time of mixing the phosphate of lime with it.

No. 330. *Treating Fatty and Oily Bodies.* George Gwynne, Mortimer-street, Cavendish-square. Dated February 2, 1866.

In 1854 Richard Albert Tilgman obtained a patent for "A New Method of obtaining Free Fat Acids and Solution of Glycerine" from natural fats and oils by "the action of water at high temperature and pressure," and in 1856 George Tomlinson Bousfield obtained a patent for a like process, but at a lower temperature and pressure than those recommended by Mr. Tilgman. For obtaining "solution of glycerine," the water process, as the patentee calls the above, is a good one, but it is a failure as far as the manufacture of candles is concerned. The fat acids obtained by this process require to be distilled before good candles can be made from them, and when so treated the product is of such an inferior quality as to make the water process an unprofitable one in England. Various plans have been suggested for remedying the defect here alluded to. One party proposed to treat the fatty or oily matter, when at the temperature of 500° Fahrenheit, with one per cent. of concentrated sulphuric acid, and then to subject it to the water process. Another party proposed to mix a little sulphuric acid with the water, by the action of which the fatty matter was converted into fat acids and solution of glycerine; while a third party proposed to mix a little lime with the aforesaid water, instead of a little sulphuric acid; but none of these plans have turned out successful. The patentee has discovered that if the fat acids obtained by the water process are subjected to a further treatment by certain acids, the defect hereinbefore alluded to will be remedied. This invention therefore consists in treating the fat acids obtained by the water process with certain acids. The acid most advantageous to employ, not only on account of its cheapness, but for its strong chemical action, is sulphuric acid. Take the fat acids in question, and if they are not already of the temperature of 300° Fahrenheit, raise them to this temperature; then pour upon them in divided streams three pounds of concentrated sulphuric acid for each 112 pounds of fat acids; then leave them to repose until the dregs have settled to the bottom of the vessel in which the operation is performed; then draw off the fatty matter from the dregs and thoroughly wash it, and after washing distil it in an atmosphere of steam. Remove the dregs into another vessel, and after thoroughly washing them, distil them in a cast-iron still in an atmosphere of steam. A certain amount of benefit can be obtained by boiling for some hours the fat acids obtained by the water process with half their bulk of water to which some sulphuric or other suitable acid has been added.

No. 338. *Galvanic Batteries.* A. Horwood and C. Brumfit. Dated February 3, 1866.

This is an invention for generating electricity in a galvanic battery, and consists of an amalgam of zinc and mercury in addition to acids. The inventors have actually so limited a knowledge of the subject upon which they profess to be able to enlighten the world as to think that the very old and well-known expedient of melting zinc and mercury together, and then casting the amalgam into forms most convenient for the cells of the battery, is novel and patentable. If their knowledge of the literature of electricity is defective, their chemistry is still worse. For they first assume that during the action of the battery an oxide will arise through the acid in the cells; they next suppose that this oxide will form short circuits of electricity between each electric battery cell; and then imagine that this local action can be diminished by putting grease or oil on the surface of acid. This wonderful invention received provisional protection only; so our readers may avail themselves of the brilliant idea without fear of actions for infringement.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W. C.

2374. B. Bayliss, Pontnewydd, near Newport, Monmouthshire, "Improvements in the manufacture of iron."—September 15, 1866.

2380. P. Brash, Leith, and W. Young, Straiton, Midlothian, "Improvements in the manufacture of oil from shale and other bituminous substances."—September 10, 1866.

2413. C. W. Siemens, Great George Street, Westminster, "Improvements in smelting metallic ores, and in furnaces to be employed for that purpose."—Petition recorded September 20, 1866.

2443. J. R. Johnson, Red Lion Square, Middlesex, and F. Gale, Long Lane, Bermondsey, "Improvements in waterproofing leather, canvas, and other fabrics."—September 22, 1866.

2449. A. F. Stoddard, Glasgow, N.B., "A new or improved artificial coal or fuel."—September 24, 1866.

2473. J. Hamilton, Glasgow, N.B., "Improvements in the manufacture of fuel for heating purposes."—September 25, 1866.

2479. J. C. Sellars, Birkenhead, Cheshire, "A new and improved metalfounder's blacking, and mode of treating or preparing the same."—September 26, 1866.

Notices to Proceed.

1469. G. F. Görausson, Gefle, Sweden, "Improvements in blast furnaces and in the manufacture of iron therein."—Petition recorded May 25, 1866.

1737. S. Holmes, Lincoln's Inn Fields, Middlesex, "Improvements in the manufacture of printing ink."—June 29, 1866.

1537. A. Paraf, Manchester, "Improvements in dyeing, printing, and other operations based on chemical reactions."—A communication from M. Paraf-Javal, Thann, France.—Petition recorded June 2, 1866.

1559. W. Lawrence, Paddington, Middlesex, "Improvements in the manufacture of malt, and in apparatus for drying malt and hops."

1560. W. Lawrence, Paddington, Middlesex, "Improvements in the manufacture, and apparatus for the treatment, of worts."—June 6, 1866.

1626. L. A. de Milly, Paris, "A new process in the treatment of concrete fatty acids for the manufacture of candles called 'stearine candles.'"—June 15, 1866.

CORRESPONDENCE.

Composition of the Solar Spectrum.

To the Editor of the Chemical News.

Sir,—As your correspondent, in the Chemical News for the 28th September, seems to be familiar with the objections made by foreign philosophers, and in foreign journals, to my theory of the composition of the solar spectrum, it might have been expected that he would have searched in English works for a reply to these objections. Had he done so, he would have found—

1. That I replied to objections made by my distinguished friend the Astronomer Royal, in the *Philosophical Magazine*, 1845, vol. xxx., p. 153.

2. That I replied to objections made by Dr. Draper, of New York, in the same work, vol. xxx., p. 461.

3. That I replied to objections made by the late distinguished Italian philosopher, M. Melloni, in the same journal, vol. xxxii., p. 489; and

4. That I replied to the objections made by M. Helmholtz and M. Bernard in the first edition of my "Memoirs of the Life and Writings of Sir Isaac Newton," published in 1845, chap. v., pp. 119-125;* and in the second edition, published in 1860, chap v., pp. 103-110.

I am, &c.

D. Brewster.

Allerly, Melrose, October 15.

MISCELLANEOUS.

A Fire Self-extinguished.—A fire broke out on Saturday in the cellar of a druggist named Christian, in the Avenue Montaigne, Paris, and was brought to a termination in a singular manner. A boy had let a lighted lucifer fall on some rags, which became ignited, and the flames spread to some bottles and carboys containing various kinds of spirits and alcohol; these bursting soon flooded the cellar with a blazing liquid which emitted a smoke so suffocating that the firemen were unable to enter. Suddenly a loud explosion was heard, and the flames became extinguished as if by enchantment. Three bottles of sulphuric ether, containing in all about three quarts, had burst, and the vapour mixing with the atmospheric air had put an end to the combustion.

Magnesium Rods for Toxicological Purposes.—We have been favoured by Mr. Mellor, manager of the Magnesium Metal Company, with some bars of absolutely pure magnesium, which have been prepared for the purpose of replacing zinc for the detection of arsenic and other poisonous metals. We have submitted them to experiment, and find that they perfectly answer the object in view. Tested in Marsh's apparatus, we have not met with the faintest indication of anything which could simulate the appearance presented by arsenic. Chemists who have been in the habit of working with even the purest zinc ordinarily obtainable will appreciate this new application of magnesium. For information on the employment of this metal in toxicology, see the papers by M. Z. Roussin at pages 27 and 42, and the paper by Mr. W. N. Hartley at page 73 of this volume.

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our Correspondentswe do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. *Private* letters for the Editor must be so marked.

Vol. XIII. of the Chemical News, containing a copious Index, is now ready, price 11s. 6d., by post, 11s. 6d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I., II., and VII. are out of print. All the others are kept in stock. Vol. XIV. commenced on July 6, and will be complete in 26 numbers.

General Index to the First Fourteen Volumes of the Chemical News.—We have had an inquiry for such an index. Its compilation will be attended with considerable trouble and expense; if, however, we find our readers generally wish for one, it shall be commenced as soon as the present volume is completed. Intending subscribers will please notify their wishes to the publisher without delay.

F. C. S.—We are unable to tell you what the initials F. E. S. mean.

A Tyro.—Consult Mr. Carter Bell's table of chemical elements, which will give you all the information you require.

J. W.—The information was given three weeks ago.

K. C. Y.—Your letter has been handed to the publisher, who will attend to the request.

W. S.—Messrs. Prentice and Co. supply gun-cotton of all densities and compression.

F. W. W.—The acid is probably trithionic acid, which has been observed by M. St. Pierre to be formed from bisulphite of potash by spontaneous reduction.

"*Carbollic Acid.*"—There is no foundation for the assertion. It is merely one of the numerous hallucinations of a person who attained an unenviable notoriety in the chemical world some time ago.

George F.—Professor Wurtz's articles will be concluded in two or three numbers. They will immediately be published in a separate volume.

Alpha.—*Appearances of Good and Diseased Meat.*—See page 48 of our last volume, where you will find some very simple and excellent directions written by Dr. Letheby.

Iodine.—Will our correspondent favour us with further particulars on the subject spoken of in his letter? It is likely to be of commercial importance.

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W. wishes to know whether he can find in any English work a full account of the properties and methods of distinguishing by means of the microscope the various ferments found in beer, and whether it is known under what conditions one species can be transformed into another.

* In the passage here referred to, p. 124, line 18, for *influential* read *uninfluential*, and in line 22 for *on* read *in*.

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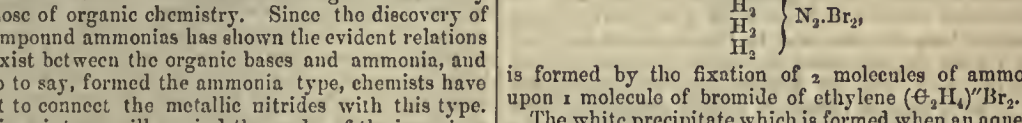
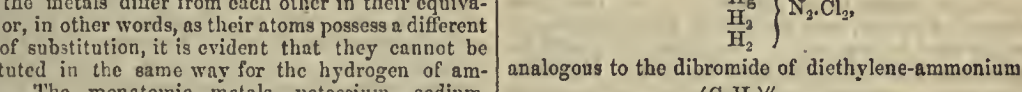
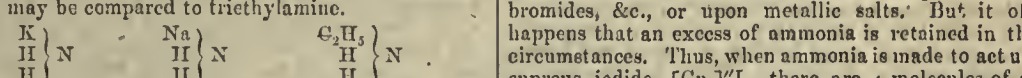


The diatomic metals—copper, cobalt, mercury, &c.—can replace two atoms of hydrogen. We have compared them to ethylene, and there exist a certain number of metallic amines which may be compared to the ethylenic bases so well studied by Dr. Hofmann.

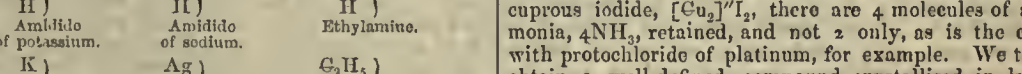
We know ammoniacal combinations of cobalt, copper, mercury, and platinum in which these metals replace 2 atoms of hydrogen in 2 molecules of ammonium, as ethylene is substituted for 2 atoms of hydrogen in 2 molecules of ammonium.



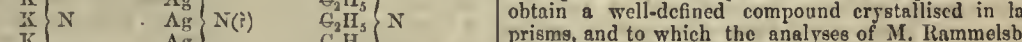
Thus, to take some examples, acetate of cupriconinm (ammoniacal acetate of copper), which crystallises in oblique rhomboidal prisms, contains:—



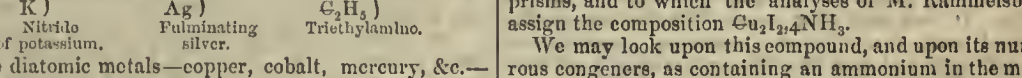
The green salt of Magnus (ammoniacal protochloride of platinum) is the dichloride of platosonium,



We must observe that it is produced by the fixation of 2 molecules of ammonia upon 1 molecule of protochloride of platinum,

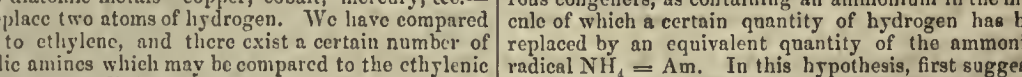


as bromide of ethylene-ammonium,

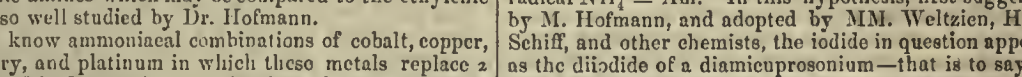


is formed by the fixation of 2 molecules of ammonia upon 1 molecule of bromide of ethylene $(C_2H_4)''Br_2$.

The white precipitate which is formed when an aqueous solution of corrosive sublimate is treated with ammonia, and which is known by the name of chloramidide of mercury, is a dichloride of dimercurammonium:—



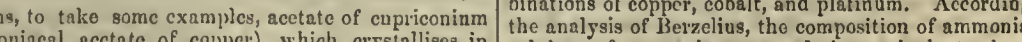
analogous to the dibromide of diethylene-ammonium,



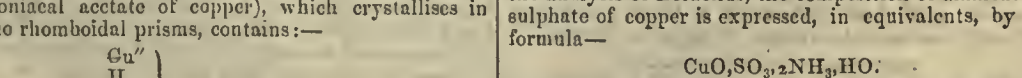
All these ammonio-metallic compounds are formed by the fixation of the elements of ammonia upon chlorides, bromides, &c., or upon metallic salts. But it often happens that an excess of ammonia is retained in these circumstances. Thus, when ammonia is made to act upon cuprous iodide, $[Cu_2]''I_2$, there are 4 molecules of ammonia, $4NH_3$, retained, and not 2 only, as is the case with protochloride of platinum, for example. We thus obtain a well-defined compound crystallised in large prisms, and to which the analyses of M. Rammelsberg assign the composition $Cu_2I_2,4NH_3$.

We may look upon this compound, and upon its numerous congeners, as containing an ammonium in the molecule of which a certain quantity of hydrogen has been replaced by an equivalent quantity of the ammonium radical $NH_4 = Am$. In this hypothesis, first suggested by M. Hofmann, and adopted by MM. Weltzien, Hugo Schiff, and other chemists, the iodide in question appears as the diiodide of a diamicuprosonium—that is to say, of the cuprosonium (page 193), in which 2 atoms of hydrogen have been replaced by $2NH_4 = Am_2$.

Similar remarks apply to the other ammoniacal combinations of copper, cobalt, and platinum. According to the analysis of Berzelius, the composition of ammoniacal sulphate of copper is expressed, in equivalents, by the formula—



This body may be regarded as a sulphate of diamicupriconium—



* *Annalen der Chemie und Pharmacie*, vol. xcvii., p. 19.
† *Ibid.*, vol. cxxiii., p. 1.
‡ Or metallic ammoniums, if the substitution is considered as taking place in ammonium.

Similarly, Henry Rose has analysed a combination of ammoniacal chloride of cobalt, which forms the chloride of diamicobaltosonium—

$$\left.\begin{matrix} Co'' \\ Am_2 \\ H_2 \\ H_2 \end{matrix}\right\} N_2.Cl_2.$$

(To be continued.)

Note on Fractional Distillations, by Henry Seward.

In distilling fractionally a liquid containing several substances of different boiling points, it is noticed that the thermometer remains stationary for a considerable time at certain temperatures, and in the distillate collected within a few degrees round one of these fixed points, chemists naturally look for definite chemical compounds; and if, after tedious labour in a field previously little worked upon, an investigator obtain something of a uniform specific gravity, definite chemical composition, and tolerably constant boiling point (there being no known substance boiling at that temperature), it is natural for him to assume the discovery of a new compound.

It does not appear to be generally known that some mechanical mixtures, upon distillation, yield substances of tolerably fixed boiling points. For instance, a mixture of carbolic and cresylic acid, upon distillation, yields oils boiling pretty constantly at intermediate temperatures, the bulk of which may be collected at the same temperature upon re-distillation. The boiling point of carbolic acid being 184° C., and that of cresylic acid being 203° C., the thermometer appears to indicate that the distillate consists of three bodies, having respectively the boiling points of $(184\times2+203)\div3=190{\cdot}3°$, $(184+203)\div2=193{\cdot}5°$, and $(184+203\times2)\div3=196{\cdot}6°$; the greater part consisting of an oil boiling at 193·5°, and having a specific gravity of 1056·3. Upon fractionating by re-distillation several times, those oils obtained at 190·3° and 196·6° easily split up, but the one at 193·5° appears tolerably constant, and at each distillation only yields a little liquid above and below that point. It was only after nearly fifty distillations that I could break it up into its components, carbolic and cresylic acid, and even then the separation was not complete. The cresylic acid obtained had the specific gravity 1034·1.

Now, as I was working upon a liquid the composition of which was pretty well known, the circumstance here mentioned occasioned no further inconvenience than a somewhat considerable expenditure of time; but had I been working upon a mixture whose composition I could not have suspected, the probability is that the result of my labours would have been the supposed discovery of a new tar acid, of the composition $(C_6H_6O+C_7H_8O)=C_{13}H_{14}O_2$, having the specific gravity 1056·3, and boiling at 193·5°, but decomposing somewhat on distillation.

Several liquids derived from coal tar, paraffin oil, or petroleum, have been described as having an almost fixed point of distillation, but decomposing slightly during the operation. It is not unlikely that future research will show that some of these are definite, although mechanical, mixtures of analogous liquids.

Fire-proof Gloves.—At a recent meeting of the Polytechnic Institute a glove of Hungarian make was exhibited. It is of asbestos, which the maker professed is adapted to enable an assayer to hold a heated crucible, but which the exhibitor had not tested. The cost was $20 per pair.—*American Journal of Mining.*

TECHNICAL CHEMISTRY.

The Smoke Question, by Dr.* F. C. Calvert, *F.R.S.*

The action of the products of the distillation of coal upon vegetation varies a great deal according to the circumstances under which they have been produced; thus, the products of the perfect combustion of coals may be represented by carbonic acid, and water with small quantities of nitrogen and sulphuric acid, all of which are invisible gases having no action on vegetation except sulphurous acid. But if coals are introduced into a gas retort, and heat be applied, the products given off are numerous, chemists having already isolated and characterised more than thirty distinct substances, many of which are most destructive to both animal and vegetable life, being highly poisonous when administered in even minute quantities; therefore, the products obtainable from coals vary enormously according to the circumstances under which they are produced. The above statement will enable us better to understand what is commonly called "smoke," and the reasons why it varies so considerably in composition. Thus the smoke issuing from the chimneys of private dwellings may be considered on the whole as belonging to the class where perfect combustion occurs, for the gases, as they emerge from the chimney, carry with them only carbonic acid, carbonic oxide, and sulphurous acid, and a small quantity of the most volatile hydrocarbons which are given off, but this only takes place at the time and shortly after the coals are freshly added to the fire, the less volatile products being condensed in the flue of the chimney, forming what is called soot; but as soon as the volatile products (which are characterised by burning with flame when coals are put on the fire at first) are consumed, the carbonaceous mass which remains in the fireplace may be considered as undergoing perfect combustion, and emitting, as above stated, only gases, having little or no action on vegetation or man, more especially when they become diffused in the atmosphere. But the results of burning coals under the steam boilers employed in our large factories are very different.

1st. Because coals are constantly being added to the mass in combustion. There is not, consequently, that cessation of the distillation of tarry products above stated, as taking place in the fireplace of private dwellings, and it follows that the products of perfect combustion, which are generated near the grates of the fireplaces in factory furnaces, are constantly mixed with a considerable quantity of tarry substances produced by the distillation of the coals, and therefore through their imperfect combustion.

2nd. As stated above, in the chimneys of our dwellings the draught is such as to permit many of the imperfect products of combustion or most of the tarry products to condense, whilst in the tall chimneys erected in our factories the draught is such as to carry out from them the above noxious volatile products, and as many of them will easily condense into liquids and solids when they come into contact with a cold atmosphere, they cannot diffuse nor be carried far before they fall upon plants and other bodies existing in the neighbourhood of such chimneys, and as many of the tarry products are highly poisonous to plants, they affect vegetation in a very marked manner.

* Read before the Social Science Congress, Manchester meeting, on the occasion of the discussion—"How far are smoke and the products of combustion arising from various manufacturing processes injurious to health?" "What measures ought to be taken to prevent the contamination of the atmosphere from such causes?"

3rd. "Black smoke" is a mixture of the products of the imperfect combustion of coal with carbon in a high state of division; the solid particles of carbon when floating in the atmosphere become, like all solids, centres of attraction for fluids, and thereby assist in the condensation of the liquid and poisonous products above mentioned, and help to carry and fix them on the surrounding vegetation, which is characterised by a deposit of such products upon the surface of the leaves and bark of plants, and which prevents that free contact with the elements of the atmosphere which is so essential to their health and growth; for, as you are aware, plants absorb carbonic acid from the atmosphere from which their carbon is derived, and they reject oxygen and watery vapour. Further, the intensity of these actions is in exact ratio with the intensity of light, and when "black smoke" is produced in large quantities it interferes with the rays of light arriving on the surface of the earth, and thereby affects vegetation materially. It appears to me that the above facts give an explanation of the activity of vegetation observed in London as compared with that witnessed in Manchester, Leeds, Sheffield, Birmingham, &c. I am well aware that the vegetation in these towns may be slightly affected by the large proportion of sulphurous acid which the smoke issuing from the factory chimneys contains as compared with the quantity of sulphurous acid produced by the consumption of a better class of coal in London; but sulphurous acid, like all gases, has such a high diffusive power, and the mass of air with which it mingles is so considerable, owing to the high temperature at which it leaves the top of the high chimneys, that, although it may somewhat affect vegetation, still I consider its action is comparatively small in proportion to the injury effected by the fixation of "black smoke" upon plants, &c., as described above. As to the comfort which the inhabitants of our large manufacturing towns would derive from the perfect combustion of the fuel in our large mills, works, &c., no one can venture to say, at all events, as a matter of health and comfort, an opinion can be formed by comparing the state of the atmosphere in large towns like Manchester on the Sabbath as compared with that which is witnessed on the other days of the week. It is hardly necessary to add that it is on record in evidence before a committee of the House of Commons that manufacturers can effect a saving of 15 or 20 per cent. by burning their smoke, and it is most painful to reflect that after such weighty evidence which has been adduced by many of the leading manufacturers of Manchester, such as Messrs. Bazley, J. Whitworth, Henry Houldsworth, &c., before a committee of the House of Commons some twenty years ago, we should still live in such a noisome, unsightly, and unwholesome atmosphere as we in this city experience; and lastly, to witness how Acts of Parliament are put on one side, when they are to be carried and enforced by local authorities who are in such cases the offenders and at the same time the authorities called upon to inflict fines and punishment.

A Mountain of Salt.—Washington correspondence alludes to specimens of salt sent to the Postmaster-General from the district of Pahranagat, in the State of Nevada, which are said to have been taken from "a mountain of pure salt, several layers in extent and several thousand feet in height." Through salt blocks of a foot square a newspaper can be read, they are so transparent. This salt deposit must prove of great value to the district, as it is largely used, in many processes, for the treating of silver ore.—*American Journal of Mining.*

NOTICES OF BOOKS.

Zeitschrift für Chemie. No. 17.

The following are the titles of all the articles in this number, with the exception of such as are quoted from other journals and have already been noticed:—

"*On the Action of Nitrate of Potash on Salts of Triethylamine*," by A. Geuther.

"*On the Formation of Prussic Acid from Methylamine*," by Bernhard Tollens.

"*On Formic Allyl Ether*," by Bernhard Tollens.

"*Preliminary Communication on the Products of the Oxidation of Mesitylene*," by R. Fitig.

"*Remarks on Poisoning by Charcoal Fumes*," by A. Fröhde.

"*Specific Gravities of Solutions of some Vitriols (Metallic Sulphates)*," by Dr. Gerlach.

"*On Cements*," by T. Schwartze.

"*On the Application of Hyposulphite of Soda to Qualitative and Quantitative Analysis and in the Preparation of Chemicals*," by A. Fröhde.

"*On Paliconrea Marcgravii St. Hil. (Ratsbane)*," by Dr. T. Peckolt.

"*On the Formation of Hyoscyamine*," by Professor Dr. Ludwig.

"*On a Sulphate of Cobalt with Four Atoms of Water*," by A. Fröhde.

The remainder of the number is filled with the introduction to Professor Stas's new memoir on the atomic weights.

Chemisches Central Blatt. Nos. 43, 44, 45, 46.

Nos. 44 and 45 contain an article

"*On the Gases which are evolved by the Destructive Distillation of Bodies*," by Dr. E. Blumtritt.

No. 46 contains a short extract

"*On neutralising Acidity in Photographic Silver Baths*," by Dr. Vogel.

With these exceptions the whole of these numbers are filled with articles which have already been noticed in our pages.

Journal für praktische Chemie. No. 14.

The articles in this journal are as follows:—

"*An Analysis of the Drinking Waters of Driburg, the Horster Mineral Wells, and the Sulphurous Mud Baths*," by Dr. R. Fresenius.

"*On the Preparation of Oxygen*," by Dr. C. Winkler.

"*On the Purification of Graphite*," by the same author.

"*On the Preparation of Indium*," by the same author.

"*On the Addition of Hydrogen to Acrolein.*"

"*On some Derivatives of Indigo Blue.*"

"*On Resorcine*," by G. Malin.

"*On the Reaction of Zinc Ethyl on Sulphide of Carbon*," by A. Graf-Grabowski.

"*Researches on Sulphate of Cobaltipentamine*," by C. D. Braun.

"*On the Occurrence of Quercetine in Calluna vulgaris Salisb.*," by Dr. F. Rochleder.

"*On the Equivalents of Cobalt and Nickel*," by Dr. Sommeruga.

"*On New Constituents of Wine*," by Professor Brucke.

"*On the Occurrence of Lactic and Acetic Acids in Beer*," by Dr. Vogel.

Chemical Society.—The first meeting of the Session will take place on Thursday evening next at 8 o'clock, when the following papers will be read:—Dr. Sprengel: "Specific Gravities of Heterogeneous Liquids." Messrs. Chapman and Thorp: "Gradual Oxidation of Organic Bodies."

REPORT ON THE

CHEMICAL LABORATORIES

IN COURSE OF ERECTION IN THE

UNIVERSITIES OF BONN AND BERLIN.

Preliminary Remarks.

Of the six Prussian Universities,* two, and those the most important ones, the Universities of Bonn and Berlin, had hitherto remained without chemical institutions in keeping with the advancement of science, and corresponding to the demands of the present day. In Breslau, Königsberg, Greifswald, and still more lately in Halle, laboratories have been built on a scale fully meeting the requirements of those universities. A long time since, the Prussian Government had decided to provide in like manner for Bonn and Berlin, but a singular combination of circumstances had hitherto always frustrated these efforts, and it was reserved for his Excellency Dr. von Mühler, the present Minister of Public Instruction, to supply the long-felt want in a manner unprecedented in the history of chemical education. To the liberal spirit in which the leading officers of the Ministry of Public Instruction, more especially Dr. Lehnert, the Under-Secretary of State, and Messrs. Knerk and Olshausen, members of the Council, have seconded the intentions of their chief, the Universities of Bonn and Berlin will shortly be indebted for the establishment of chemical laboratories which, as regards extent and completeness, may be placed side by side with the best appointed scientific institutions of the world.

The difficulties that stood in the way of the realisation of these great undertakings were not a few. The procuring the very considerable grant that was necessary, the choosing and securing of the sites, the drawing out of plans, and submission of them to the different committees of inspection which superintend the construction of public buildings in Prussia, and lastly, the solution of certain intricate questions which arose from the joint participation of the University and the Academy of Sciences in the Berlin Institution, were some of the preliminary conditions which required adjustment before the erection of the contemplated buildings could be proceeded with. That these difficulties have all been speedily and entirely cleared away, that the chemical institution in Bonn is now fast approaching completion, and that the walls of the new edifice in Berlin are rapidly rising, are results entirely due to Mr. Knerk, whose energy, experience, and devotion (well known in all the Prussian Universities) have never failed to these great undertakings.

The Reporter does not, he believes, deceive himself in assigning to the foundation of the two great chemical institutions now being carried out under the auspices of the Prussian Ministry of Public Instruction a significance far beyond the more immediate impetus they are sure to give to the prosecution of chemical studies in the universities to which they belong. By the grant of means unusually large for the organisation of these new schools, a tribute of recognition has been paid to the influence of chemistry on the modern aspect of the world that cannot remain without effect upon other departments of physical science which have not been less productive of useful results.

Side by side with the two new chemical schools now springing into existence, other institutions are sure to be founded, similar in nature and appointed with the same liberality, for the prosecution of the two other great branches of natural science, physics and physiology, to which, as well as to chemistry, the future belongs.

This subject is already being freely agitated in the Prussian Universities, especially those of Bonn and Berlin. The leaders in the several branches of natural science are persuaded that the great efforts which at the present moment are being made for chemistry will, sooner or later, benefit their own departments. It is not, however, in Prussia, or in Germany alone, that the wholesome influence of this example appears to be felt. The exertions of the Prussian Ministry of Public Instruction in the cause of chemical science have attracted the attention even of foreign governments. Inquiries respecting the new institutions have already been made by several other countries, more especially by England and France, and it is not unlikely that the noble precedent set by Prussia will soon be followed by the establishment of similar schools elsewhere. It is in this sense, at all events, that the writer ventures to interpret the desire expressed by her Majesty's Government to obtain information on the subject of the two institutions in process of organisation in the Universities of Bonn and Berlin, which, at the request of the Prussian Minister, he has endeavoured to supply by drawing up the following statement. He would, indeed, consider himself fortunate if this Report, which, from the nature of the case, cannot be more than an outline, should assist in augmenting the interest already felt for the establishment of a great chemical institution in the metropolis of the world, an institution which England can no longer dispense with, since no country is more deeply interested than she in the rapid diffusion of the latest results of chemical inquiry.

It will materially facilitate the treatment of the subject to consider the two institutions apart from one another. The Reporter proposes, in the first place, to give an account of the laboratories of the University of Bonn, which were earlier conceived and earlier begun, and are, consequently, in a far more advanced stage than those of the University of Berlin.

The Chemical Laboratories of the Rhenish Frederick William University of Bonn.

The first negotiations respecting the building of a new laboratory in Bonn go back as far as 1861. In the summer of that year the Reporter was invited by his friends, Professors Plücker and Sell, to an interview with Mr. Beseler, the Curator of the University of Bonn. Fully appreciating the importance of a large chemical school for the development of the university committed to his charge, and of the rapidly advancing industry of the Rhenish provinces, Mr. Beseler had even then conceived the idea of founding the new institution, to which he has since devoted all the powers of his energetic nature. In fact, Bonn, from its very position, seemed intended for the site of a great central chemical establishment, no other German University being able to enter the lists with her in this respect.

Situated on the high road of Europe, on the banks of the mighty Rhine, surrounded by some of the most charming scenery of the world, distant but a few hours from the Belgian frontier, and scarcely farther removed from France, within reach of England by a short day's journey, in the midst of large agricultural, wine-growing, and mining populations, in close proximity with the great manufacturing districts of Rhineland and Westphalia (whose fast-increasing industry has earned for them the name of the German Lancashire), united with the focus of this large industrial territory by a network of railways whose meshes are augmenting daily, already the seat of one of the most flourishing universities in Germany—the city of Bonn embodied a number of conditions which could not fail to secure the rapid success of a large chemical institution established within its walls.

But little time elapsed before the first steps for the

* The Report was written before the "Seven Days' War." With the newly-acquired territories, Prussia has gained three additional Universities—viz., Kiel, the University of the Elbe Duchies; Gottingen, that of the former Kingdom of Hanover; and Marburg, the University of the former Electorate of Hesse-Cassel.

August 20, 1866. A. W. H.

foundation of the new chemical school were taken. The negotiations already pending between the Minister of Public Instruction and the Curator of the University were soon concluded, and in the beginning of 1862 Mr. Beseler was commissioned by the Minister to inquire of the Reporter whether he would undertake the organisation and direction of a chemical laboratory to be established in the University of Bonn, on a magnificent scale, and liberally provided with all the requirements for modern investigation. The question thus opened led to a series of negotiations which ended, in the spring of 1863, in the Reporter complying with this honourable proposal.

The important duty of drawing out the plans of the new institution devolved on Mr. Augustus Dieckhoff, architect to the University. This was not an easy problem. The programme of an institution for the purposes of chemical education embraces a variety of conditions such as are seldom presented to an architect, and of which the artistic realisation is impossible without unlimited zeal. This difficult task could not have fallen into better hands. The felicity with which Mr. Dieckhoff has solved the problem, the thorough knowledge and perfect understanding of the various objects claimed in the programme, and the great care bestowed upon their attainment, must be evident to every one who examines with attention the drawings (unfortunately only small and imperfect sketches) which accompany this report.

In preparing the programme, the composition of which fell to the lot of the Reporter, it appeared all-important to gather information as exact as possible respecting the chemical institutions already in existence, either by examination of the plans or, better still, by personal inspection of the buildings themselves, and consultation with their several directors.

The Reporter was fortunate enough to obtain drawings and plans of nearly every existing laboratory, and he avails himself of this opportunity of expressing his hearty thanks to all those who have kindly assisted him in their collection. The chief experience, however, was gathered during a journey of several months through Germany, which, in company with the architect, he undertook in the autumn of 1863. On this occasion nearly all the German laboratories were studied, from that of Giessen,† the first German university laboratory, erected by the father of the Reporter more than a quarter of a century ago for Liebig, down to the more recently founded chemical schools of Karlsruhe,‡ Munich,§ Zurich, Heidelberg,‖ and Gottingen, and the splended institution just completed in the University of Greifswald.¶

The fruit of this expedition was the development of a goodly series of designs, following each other in rapid succession. After many animated discussions, an elaborate plan, embodying the experience thus gathered from all quarters, was at last fixed upon, to which, in the beginning of the winter of the same year, all those more especially concerned had given their adhesion. This plan, the detailed contract for which amounted to 123,000 thalers (18,450*l.*), passed, with scarcely an alteration, the several stages of supervision, and was ultimately sanctioned by Government.

The first turf was turned late in the autumn of 1864; the spring of 1865 saw the foundation-stone laid; and the building, the construction of which was entrusted to an able young architect, Mr. Jacob Neumann, who had already most efficiently assisted in preparing the plans, is at present being roofed in, so that in the summer of 1867 it may be handed over to the University.

Of the several institutions of the Rhenish University, part only is situated in the former Electoral Castle at Bonn, granted to the University at its foundation in the year 1818; others, for instance, the natural history collections, the magnificent and world-renowned astronomical observatory, the chemical laboratory used up to the present time, the botanic gardens, the agricultural academy, formerly affiliated to the University, but now an independent college, are placed in the village of Poppelsdorf, about fifteen minutes' walk from the city of Bonn, but connected with it by one of the finest chestnut avenues in Germany. Some of the institutions last mentioned are lodged in the castle at Poppelsdorf, formerly the summer residence of the Elector; and it is in close proximity to this castle that a tract of land, the freehold property of the University, was chosen for the site of the new laboratory. A glance at the plan of situation (Fig. 1, page 198) and the synopsis accompanying it, shows the position of the building, with the adjoining castle, the avenues to the town, and the several University buildings more or less distant. A more favourable situation could scarcely have been found.

The land allotted by the University is of very considerable extent. The spacious building, covering with its four enclosed courts** an area of 45,000 square feet,†† is surrounded by a handsome garden, which at the back extends to some depth, leaving ample room for the erection of any outbuildings that may be required at some later time. Thus, unfettered by narrowness of space, or the prospect of having air or light shut out by the close proximity of other buildings, the architect was enabled to lay out the plan of the edifice with a degree of freedom that has materially promoted the beauty and harmony of his work. Even the soil of the site proved to be of a perfectly unexceptionable character, so that the foundations were laid without any difficulty.

The slight distance from the city of Bonn might have appeared at first sight a disadvantage. Since, however, the natural-science institutions of the University, as has been already pointed out, are, almost without exception, concentrated at Poppelsdorf, it was of material consequence to the students that the chemical laboratory should also be in that neighbourhood. Moreover, the institution was thus removed from the immediate proximity of the rapidly growing town—a circumstance which doubtless will not give less satisfaction to the occupiers of numerous suburban villas, than to the chemists whose lot it will be to work in the new laboratory. Nor is it possible, in enumerating the advantages of the site chosen for the institution, not to bestow a passing notice on the magnificent scenery surrounding this lovely spot on every side. Nothing equals the view from the upper windows of the house—on one side, the chestnut avenues and the city of Bonn with the lofty spire of its cathedral; on the other side, the castle with the adjacent botanic gardens; in the distance, the Kreuzberg with its chapel; and farther still, on the opposite bank of the Rhine, the graceful outlines of the Siebengebirge.

† An excellent description of the Giessen Laboratory, accompanied by an atlas of fine drawings, was published soon after the completion of the building. It is entitled: "Das chemische Laboratorium der Ludwigs-Universität Giessen, dargestellt von J. P. Hofmann. Mit einem Vorwort von Justus Liebig. Heidelberg, 1842."

‡ Full information respecting this laboratory is supplied by a pamphlet: "Das chemische Laboratorium an der grossherzoglichen polytechnischen Schule zu Karlsruhe. Herausgegeben von Dr. C. Weltzien und H. Lang. Karlsruhe, 1851."

§ A detailed description of the Munich Laboratory is published under the title: "Das chemische Laboratorium der Königlichen Akademie der Wissenschaften in München. Unter Mitwirkung von Justus von Liebig, erbaut von A. von Voit. Braunschweig, 1859."

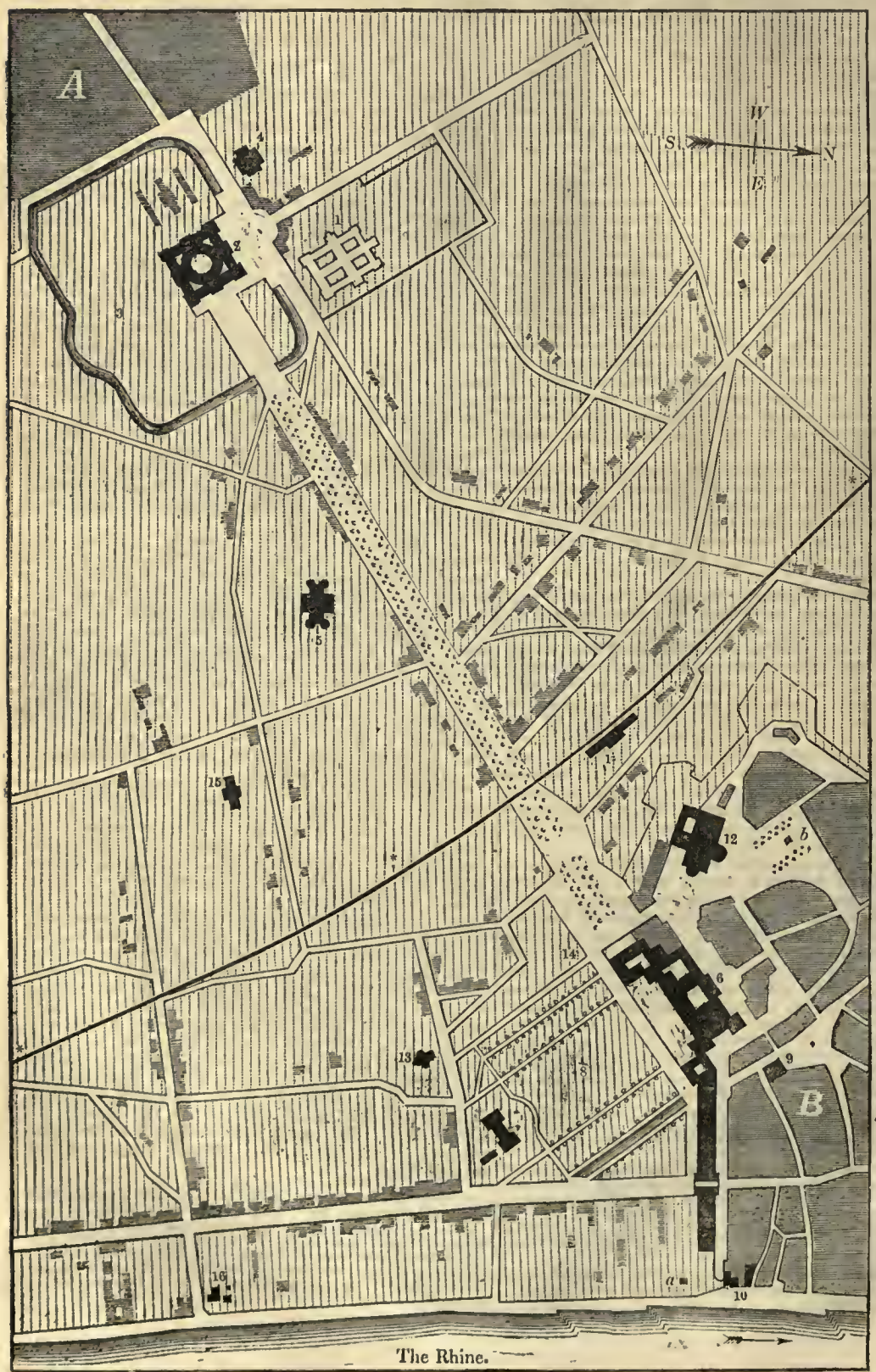
‖ Described in a separate pamphlet: "Das chemische Laboratorium an der Universität in Heidelberg. Herausgegeben von H. Lang. Karlsruhe, 1858."

¶ Comp. "Das chemische Laboratorium der Universität Greifswald, von G. Müller; "in "Zeitschrift für Bauwesen redigirt von G. Erbkam," Jahrgang xiv., S. 330.

** These four courts have suggested to a witty member of the University the name of *Chemical Escurial* for the building.

†† All the measures employed in this Report are Rhenish, at present the legal Prussian measure, but which will shortly, it can no longer be doubted, give place to the French mètre. It appeared useless to convert the Rhenish measure into English, the difference between the two being so very trifling. A Rhenish foot of 12 inches is equal to 1·022 English feet.

Fig. 1.—Plan of Situation of the New Laboratories of the University of Bonn.



Synopsis.

A.) *Poppelsdorf.*
B.) *Bonn.*
1. New Chemical Laboratories.
2. Poppelsdorf Castle.
3. Botanic Gardens.
4. Agricultural Academy.
5. Observatory.
6. University.
7. Anatomical School.
8. Garden of the University (*Hofgarten*).
9. Townhall.
10. General Office of Mines.
11. Railway Station.
12. Cathedral.
13. Jesuit Church.
14. Site for the new Protestant Church.
15. Frederick William Hospital.
16. Arndt's Residence.
a. Statue of Arndt.
b. Statue of Beethoven.
** Railway from Coblence to Cologne.

As yet only one public road leads to the south-east side of the building, turning off to the castle. The further development of building enterprise in the neighbourhood of Bonn will, however, doubtless before long provide a second street, returning to the town on the north-east side of the ground.

The new chemical institution is provisionally intended for sixty students; the space, however, has been meted out so liberally that accommodation could be supplied without inconvenience to a much greater number; besides this, the building has been so constructed as to allow of enlargement at any future time by raising a second story, without detracting from the harmony of its structure, either as regards outward appearance or internal arrangement.

In addition to the various apartments required for educational purposes, for practical analysis, for scientific and technical investigations, and, lastly, for the lectures, there are in the new building sets of rooms for the castellan of the institution, for the *famulus* and servants, apartments for three assistants, and also a magnificent residence for the director, consisting of a suite of rooms, which, as regards number and size, could be very seldom met with in a private house. Lastly, there is a considerable number of well-lighted basement rooms, which have as yet no special use assigned to them, but the construction of which, on account of the greater depth of the foundations on the street side, could not be avoided. On any subsequent enlargement of the institution, however, these rooms could not fail to be adapted to some useful purpose.

The various departments of the building are spread over three floors—the basement, the ground floor, and the first floor. The first floor, however, extends over but a small portion of the structure, and is exclusively occupied by the private apartments of the director. But few of the rooms devoted to the purposes of the institution are found in the basement—as, for instance, the store-rooms, the rooms for metallurgical and other operations requiring large quantities of fuel, those for medico-legal and chemico-physiological research, &c. All the remaining space intended for educational purposes—viz., the laboratories, with their adjoining rooms for special operations, and side-rooms, balance-rooms, rooms for volumetric analysis, combustion-rooms, lecture-theatres, the museums of specimens, the study and private laboratory of the director, the apartments of the assistants and other officers of the institution—are, one and all, on the ground floor—an advantage which could not have been obtained had the site of the building been of more limited dimensions.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

BRITISH ASSOCIATION, NOTTINGHAM MEETING.

Friday, August 24.

A Lecture "On the Results of Spectrum Analysis, as applied to the Heavenly Bodies," by William Huggins, *F.R.S.*

(*Continued from page 188.*)

COLOURS OF THE STARS.

When the air is clear, especially in Southern climes, the twinkling stars do not all resemble diamonds, here and there may be seen in beauteous contrast richly coloured gems.

The colour of the light of the stars which are bright to the naked eye is always some tint of red, orange, or yellow. When, however, a telescope is employed, in close companionship with many of these ruddy and orange stars, other fainter stars become visible, the colour of which may be blue, or green, or purple.

Now it appeared to us to be probable that the origin of these differences of colour among the stars might be indicated by their spectra.

Since we had found that the source of the light of the stars was incandescent solid or liquid matter, it appeared to be very probable that at the time of its emission the light of all the stars was white alike. The colours observed amongst them must then be caused by some modification suffered by the light after its emission.

Again, it was obvious that if the dark lines of absorption were more numerous, or stronger, in some parts of the spectrum, then those colours would be subdued in power, relatively to the colour in which few lines only occur. These latter colours remaining strong would predominate, and give to the light, originally white, their own tints.

These suppositions have been confirmed by observation.

Mr. Ladd will throw upon the screen the spectrum of Sirius, which may be taken as an illustration of the stars, the light of which is white.

As might be expected, the spectra of these stars are remarkable for their freedom from strong groups of absorption-lines. The dark lines, though present in great number, are all, with one exception, very thin and faint, and too feeble to modify the original whiteness of the light. The one exception consists of three very strong single lines; one line corresponding to Fraünhofer's C, one to F, and the other near G. Two of these certainly indicate the presence of hydrogen. This peculiarity, which seems invariably connected with colourless stars, is very suggestive, and invites speculation. May it be a sign of a temperature of extreme fierceness?

Let us now examine the spectrum of an orange star.

This diagram represents the spectrum of the brighter of the two stars which form the double star in Hercules. In the spectrum of this star the green and blue parts of the light, and also the deep red, are subdued with strong groups of lines, while the orange and yellow rays preserve nearly their original intensity, and therefore predominate in the star's light.

The question yet remains to be answered:—Will the faint telescopic stars, which are blue, green, and purple, and which are never found alone in the heavens, but always under the protection of a strong ruddy or orange star, furnish spectra in accordance with this theory?

With some little difficulty, and by means of a special arrangement of the spectrum apparatus, we succeeded in observing the spectra of the components of some double stars. There will now be thrown upon the screen the well-known double star β Cygni. In a large telescope the colours of the two stars are beautifully contrasted, as they now appear upon the screen. The upper spectrum represents the orange star, the lower one that of its beautiful but feeble companion. In the orange star you observe that the dark lines are strongest, and most closely grouped in the blue and violet parts of the spectrum; and the orange rays, therefore, which are comparatively free from lines, predominate.

In the delicate blue companion, the strongest groups of lines are found in the yellow, orange, and in part of the red. In the arrangement of these groups of lines we have a sufficient cause for the predominance of the other portions of the spectrum, which unite in the eye to give the blue purple colour of the light of this star.

We have, therefore, shown that the colours of the stars are produced by the vapours existing in their atmosphere. The chemical constitution of a star's atmosphere will depend upon the elements existing in the star, and upon its temperature.

VARIABLE STARS.

The brightness of many of the stars is found to be variable. From night to night, from month to month, or from season to season, their light may be observed to be continually changing, at one time increasing, at another time diminishing. The careful study of these variable stars by numerous observers, has shown that their continual changes do not take place in an uncertain or irregular manner.

The greater part of these remarkable objects wax and wane in accordance with a fixed law of periodic variation which is peculiar to each.

We have been seeking for some time to throw light upon this strange phenomenon by means of observation of their spectra. If in any case the periodic variation of brightness is associated with physical changes occurring in the star, we might obtain some information by means of the prism. Again, if the diminution in brightness of a star should be caused by the interposition of a dark body, then, in that case, if the dark body be surrounded with an atmosphere, its presence might possibly be revealed to us by the appearance of additional lines of absorption in the spectrum of the star when at its minimum. One such change in the spectrum of a variable star we believe we have already observed.

Betelgeux is a star of moderate degree of variability. When this star was at its maximum brilliancy in February last, we missed a group of lines, the exact position of which we had determined, with great accuracy by micrometric measurements, some two years before.

We have observed the spectra of several variable stars at different phases of their periodic variation, but our results are not yet complete.

It is worthy of notice that the variable stars which have a ruddy or an orange tint possess spectra analogous to that of Betelgeux and β Pegasi.

TEMPORARY STARS.

With the variable stars, modern opinion would associate the remarkable phenomena of the so-called new stars, which occasionally, but at long intervals, have suddenly appeared in the sky. But in no case has a permanently bright star been added to the heavens. The splendour of all these objects was temporary only, though whether they died out or still exist as extremely faint stars is uncertain. In the case of the two modern temporary stars, that seen by Mr. Hind in 1845, and the bright star recently observed in Corona, though they have lost their ephemeral glory, still continue as stars of the tenth and eleventh magnitudes.

The old theories respecting these strange objects must be rejected. We cannot believe with Tycho Brahe that objects so ephemeral are new creations, nor with Riccioli that they are stars, brilliant on one side only, which have been suddenly turned round by the Deity. The theory that they have suddenly darted towards us with a velocity greater than that of light, from a region of remote invisibility, will not now find supporters.

On May 12 last a star of the second magnitude suddenly burst forth in the constellation of the Northern Crown. Thanks to the kindness of the first discoverer of this phenomenon, Mr. Birmingham, of Tuam, I was enabled, conjointly with Dr. Miller, to examine the spectrum of this star on May 16, when it had not fallen much below the third magnitude.

The spectrum of this star consists of two distinct spectra. One of these is formed by four bright lines. The other spectrum is analogous to the spectra of the sun and stars.

These two spectra represent two distinct sources of light. Each spectrum is formed by the decomposition of light, which is independent of the light which gives birth to the other spectrum.

The continuous spectrum crowded with groups of dark lines shows that there exists a photosphere of incandescent solid or liquid matter. Further, that there is an atmosphere of cooler vapours which give rise by absorption to the group of dark lines.

So far, the constitution of this object is analogous to that of the sun and stars, but in addition there is the second spectrum, which consists of bright lines. There is therefore a second and distinct source of light, and this must be, as the character of the spectrum shows, luminous gas. Now the two principal of the bright lines of this spectrum inform us, by their position, that one of the luminous gases is hydrogen. The great brightness of these lines shows that the luminous gas is hotter than the photosphere. These facts, taken in connexion with the suddenness of the outburst of light in the star, and its immediate very rapid decline in brightness, from the second down to the eighth magnitude in twelve days, suggested to us the startling speculation that the star has become suddenly enwrapped in the flames of burning hydrogen. In consequence, it may be, of some great convulsion, enormous quantities of gas were set free. A large part of this gas consisted of hydrogen which was burning about the star in combination with some other element. This flaming gas emitted the light represented by the spectrum of bright lines. The spectrum of the other part of the star's light may show that this fierce gaseous conflagration had heated to a more vivid incandescence the solid matter of the photosphere. As the free hydrogen became exhausted the flames gradually abated, the photosphere became less vivid, and the star waned down to its former brightness.

We must not forget that light, though a swift messenger, requires time to pass from the star to us. The great physical convulsion which is new to us is already an event of the past with respect to the star itself. For years the star has existed under the new conditions which followed this fiery catastrophe.

(To be continued.)

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, October 2, 1866.

Edward Schunck, *Ph.D., F.R.S., &c., President, in the Chair.*

Among the donations announced was one from Mr. Cottam, of a framed memorial, presented by the Society to Dr. Dalton in 1844, on the occasion of his communicating to them the 50th annual result of his meteorological observations. In a letter accompanying the memorial, dated September 5, 1866, Mr. Cottam says: "At the Doctor's death it remained in the hands of our old friend, Peter Clare, at whose sale it was purchased by my late father, and has since hung up in my office as a fine specimen of caligraphy. I think the Society's rooms will be the most suitable place for it, and that the centenary anniversary of the Doctor's birth is a suitable occasion for its presentation."

On the motion of Mr. Binney, seconded by Mr. Gaskell, the thanks of the Society were unanimously voted to Mr. Cottam for his interesting donation.

A paper was read "*On the Portraits of Sir Isaac Newton; and particularly on one of him by Kneller, painted about the time of the publication of the 'Principia,' and representing him as he was in the prime of life,*" by Samuel Crompton, M.D.

The writer pointed out that all Newton's great discoveries were made prior to 1688, and directed attention to the following dates: That he was born in 1642, died in 1727, and that he discovered fluxions in 1665-6, the unequal refrangibility of light in 1666, the reflecting telescope in 1668, and published the "*Principia*" in 1687; and that with that publication, which Whewell has designated "The Great Charter of Modern Science," his career, as an original discoverer, appears to have terminated. He quoted passages from Mr. Edleston's correspondence of Newton and Cotes, and from Sir David Brewster's larger life of Newton, to show that his appointment to the Mint, in a great measure, stopped further researches. "Henceforward," says Mr. Edleston, "his official duties rendered it impossible for him to work continuously at his former pursuits; and his studies in mathematics and natural philosophy were by snatches, and in the intervals of business." "His duties at the Mint," says Sir David,

"allowed him but little time for the performance of so laborious a task as the publication of a second edition of the '*Principia*,' and when his consent was at last obtained to put the work to the press, they greatly interrupted its progress." Again, in one of his letters to Flamstead, he says that he did not like to be known to be attending to anything but the King's business, meaning the duties of the Mint. Therefore, after the publication of the "*Principia*," he may be practically regarded as a retired philosopher.

The writer then attempted to show that the current portraits of Newton do not give us any correct representation of Newton the philosopher. He exhibited various engravings of Newton. He pointed out that Vertue's print, after Vanderbank, is inscribed "Isaacus Newtonus Eq. Aur. æt. 83. J. Vanderbank pinxit 1725, Geo. Vertue sculpsit 1726;" and, therefore, that the date of that celebrated picture, in possession of the Royal Society, represents him in extreme old age. This picture, therefore, he contended, was not a portrait of the great Newton, but of Newton the Master of the Mint, who assayed Wood's halfpence; and that it could not, for one moment, be accepted as a representation of Newton in the plenitude of his intellectual power, of whom Halley sang in 1687:—

> Newtonum clausi reserantem scrinia veri,
> Newtonum Musis charum, cui pectore puro
> Phœbus adest, totoque incessit numine mentem,
> Nec fas est propius mortali attingere divos.

Nor was it the portrait of him as he was when he published the second edition of his "*Principia*," but a representation of him as a grand and venerable ruin covered with the lichens of time.

But this picture of Vanderbank's the writer greatly preferred to the Houbraken and other prints published about 1710 or 1712; and he contended that the portrait published as the best extant one by Sir David Brewster as the frontispiece to his larger life of Newton, by no means gives a desirable representation of Newton the philosopher. It was rather an affected representation of Newton the dandy, and of Newton the prosperous man of the world, with a carriage and horses, and with three male and three female servants. The writer looked upon these prints with pity; and could not for one moment allow that any one of them represented that Isaac Newton, the yeoman's son, while at work in the wells of truth, and wresting from nature secrets hidden from the foundation of the world. In order to form some idea of the immortal Newton as distinguished from Queen Anne's Newton, he asked us to consider attentively the letter written by Newton's former assistant, Humphrey Newton, to Mr. Conduit, in 1727, descriptive of Isaac's manner of life and appearance between 1684 and the beginning of 1689.

"In the last year of King Charles II., Sir Isaac was pleased, through the mediation of Mr. Walker, then schoolmaster at Grantham, to send for me up to Cambridge, of whom I had the opportunity, as well as honour, to wait of for about five years. In such time he wrote his '*Principia Mathematica*,' which stupendous work, by his order, I copied out before it went to the press. . . . His carriage then was very meek, sedate, and humble, never seemingly angry, of profound thought, his countenance mild, pleasant, and comely. I cannot say I ever saw him laugh but once, which was at that passage which Dr. Stukeley mentioned in his letter to your honour,* which put me in mind of the Ephesian philosopher who laughed only once in his life time, to see an ass eating thistles when plenty of grass was by. He always kept close to his studies, very rarely went a visiting, and had as few visitors. . . . I never knew him to take any recreation or pastime, either in riding out to take the air, walking, bowling, or any other exercise whatever; thinking all hours lost that was not spent in his studies, to which he kept so close that he seldom left his chamber, except at term time, when he read in the schools as being Lucasian professor, where so few went to hear him, and fewer that understood him, that oft times he did in a manner, for want of hearers, read to the walls. . . . So intent, so serious upon his studies, that he ate very sparingly, nay, ofttimes he has forgot to eat at all, so that, going into his chamber, I have found his mess untouched, of which, when I have reminded him, he would reply,—'How I?' and then, making to the table, would eat a bit or two, standing, for I cannot say I ever saw him sit at table by himself. . . . He very rarely went to bed before two or three of the clock, sometimes not till five or six, lying about four or five hours, especially at spring and fall of the leaf, at which times he used to employ about six weeks in his laboratory, the fire scarcely going out either night or day, he sitting up one night and I another till he had finished his chemical experiments, in the performance of which he was most accurate, strict, exact. What his aim might be, I was not able to penetrate into, but his pains, his diligence at these set times made me think he aimed at something beyond the reach of human art and industry. I cannot say I ever saw him drink either wine, ale, or beer, excepting at meals, and then but very sparingly. He very rarely went to dine in the hall, except on some public days, and then if he was not minded, would go very carelessly, with shoes down at heels, stockings untied, surplice on, and his head scarcely combed. . . When he has sometimes taken a turn or two (in his garden) he has made a sudden stand, turned himself about, run up y^e^ stairs like another Archimedes, fall to write on his desk standing without giving himself the leisure to draw a chair to sit down upon . . . His brick furnaces, *pro re natâ*, he made and altered himself without troubling a bricklayer. . . He very seldom sat by the fire. . . He never slept in the day time that I perceived; I believe he grudged y^e^ short time he spent in eating and sleeping. . . His bed maker in a morning has sometimes found both dinner and supper scarcely tasted, which the old woman has very pleasantly and mumpingly gone away with. . . His thoughts were his books; though he had a large study seldom consulted with them. When he was about 30 years of age his grey hairs was very comely, and his smiling countenance made him so much the more graceful."

Surely, Dr. Crompton contended, none of the engraved portraits of Newton represents the great Newton of those years. The conceited, double-chinned Kneller's of 1710-20, give no idea of him. Dr. Crompton then exhibited an admirable engraving by Mr. Oldham Barlow,† of the recently recovered portrait of Newton, painted by Kneller in 1689, and asked whether it did not fulfil every required condition? Eyes capable of penetrating into the heart of things—a brow that could measure the universe—a face "full of godlike reason" and in its intensity and force indicating a very beagle of truth—yet what simplicity! and how contemplative! The identical white locks spoken of by Humphrey Newton, to be in a few years shorn to make way for the wig of the Houbraken print!

Dr. Crompton then gave the history of the portrait from whence this engraving has been taken, and said he identified it at the Art Treasures' Exhibition, as Newton as he was when he wrote the "*Principia*," and pointed out at that time that it was the only known portrait of Newton worthy of notice—that he obtained, in conjunction with Dr. Joule, Mr. Fairbairn, Dr. Schunck, Mr. Binney, and Dr. Angus Smith, leave from its noble owner to have it photographed; and he exhibited a print then taken—that Mr. Barlow, happening to be at his house, saw an impression of it, and expressed a wish to engrave it—that Dr. Crompton

* When Sir Isaac once laughed 'twas upon occasion of asking a friend, to whom he had lent Euclid to read, what progress he had made in that author, and how he liked him. He answered by desiring to know what use and benefit in life that study would be to him, upon which Sir Isaac was very merry.

† Of Victoria Road, Kensington, London.

obtained Lord Portsmouth's permission for the use of the original picture. He then read letters from Lord Portsmouth, proving that the portrait came into his lordship's possession by the marriage of his ancestor Lord Lymington, to the grand-niece of Newton, Miss Conduit, and that it had been in a neglected condition and recently cleaned and lined. Dr. Crompton added that Sir David Brewster told him that he went to Hurstbourne Park to examine Newton's MSS. and portraits, but that he did not see it, yet it was there. The picture, Dr. Crompton added, is in Kneller's best manner, is painted with great care, is signed in the left corner "Isaacus Newtonus," and in the right, "Godfrey Kneller fec. 1689." Dr. Crompton exhibited an engraving prefixed to Dr. Edleston's Correspondence of Newton and Cotes, which he said was from an India-ink drawing in Magdalen College, Cambridge, undoubtedly closely allied to the Kneller picture, but greatly inferior; being, in Dr. Crompton's opinion, a bad copy by an inferior hand, but, no doubt, made for Mr. Pepys, in whose collection it was.

Dr. Crompton shewed that Newton was in London during the greater part of 1689, as Member of the Convention Parliament, when it is certain that this portrait was painted; and he added, that he had not been able to discover any other portrait of him painted earlier than, or about, this interesting period of his life, nor any other, till several years later (probably twenty), when success had greatly changed his countenance.

PHOTOGRAPHICAL SECTION.

October 4, 1866.

Dr. J. P. Joule, *F.R.S., &c., Vice-President of the Section, in the Chair.*

A paper was read "*On a Process for Printing Photographs in Various Colours*," by J. A. Gatty, Esq.

My process is based upon the property possessed by ferricyanide of potassium, of forming clear solutions with certain metallic salts, producing insoluble compounds when the mixture is brought into contact with a deoxidising agent, the rays of the sun acting as such, a perfect precipitation takes place upon paper or other material prepared with the above-named solution. In producing the specimens sent herewith, I applied to the paper a concentrated solution, formed of equal parts of ferricyanide of potassium and nitrate of lead, having found the latter to answer very well, not only as a means of forming a precipitate, but also for assisting in the production of numerous colours. After drying the paper, it was exposed to the sun for about half an hour, and then washed in water in order to dissolve all the unaffected ferricyanide of potassium and nitrate of lead. I have noticed that the sun acts much quicker when there is a little moisture present. I have, therefore, placed a damp cloth between two or three thicknesses of paper behind the prepared paper. After washing, the photographic image remains behind as a pale greenish precipitate, easily transformed into various colours, as the following experiments will show:—

No. 1. (Blue.) Has been steeped in a weak solution of nitrate of iron for about ten minutes, and then washed in water.

No. 2. (Green.) Same as No. 1, but steeped in a weak solution of bichromate of potash after the nitrate of iron.

No. 3. (Reddish Brown.) Has been steeped in a solution of nitrate of copper, and then washed.

No. 4. (Brown.) Has been developed by steeping it in a mixture of weak solution of nitrate of iron and nitrate of copper.

No. 5. (Dark Brown.) Has also been treated with nitrate of iron and nitrate of copper, but containing a larger proportion of the former.

These few experiments will show that a very large number of shades may be obtained by using different salts and mixtures thereof in developing the photograph. A further series of colours may be obtained by destroying the blue with caustic soda, which, after washing, will leave behind oxides of iron and lead, which may be dyed with vegetable colouring matters.

All the above experiments have been made about four years ago, which goes to prove that the colours are permanent. I hope shortly to be able to resume my experiments, and work the process out more perfectly.

Mr. Dancer remarked that he had some prints (which were shown to the meeting) produced by Mr. Mercer in 1856, which appeared to be done by a process similar to the one just described, prussiate of potash being one of the substances used, but he was not acquainted with the details of the process.

It was considered a useful process for certain purposes, and deserved more attention than it had hitherto received.

ACADEMY OF SCIENCES.

October 15.

The papers brought forward at this meeting were principally physical, chemistry not being represented at all. The first of the papers on physical optics was

"*New Researches on the Spectral Analysis of the Light of Stars*," by Father Secchi. After pointing out several objections to the ordinary direct vision spectroscopes, particularly Hoffmann's, the author noticed some improvements in the instrument described in his last letter, which consist in placing the cylindrical lens very near the eye-piece, and the direct vision prism after the lens. This instrument produces an angular dispersion between the solar rays B and H of about 6° 51′. The eye-piece is movable, so as to include the whole spectrum, and magnifies 500 times. In order to determine the absolute position of the rays and their degree of frangibility, the author makes use of the spectra of the planets Venus and Mars, in which all the solar rays are perfectly visible, and easy to be measured; adding, "This is a great advantage, and is due to the enormous dispersion of the prism, before which the diameter of the planet almost disappears." From this it is evident that the system adopted by the Roman astronomer must be considered inferior to the one followed by English observers, inasmuch as he uses no slit, but takes as his line of light the image of the star elongated through a cylindrical lens. The author divides the stellar spectra into three types. The first and most dominant type is that exhibited by white stars, such as α Lyræ, Sirius, &c. Their characteristic is a strong black band in the green-blue in the position of the solar F, and a second band in the violet a little nearer the preceding than the solar ray G. Half the visible stars belong to this type. Two remarkable exceptions have been found. The star γ Cassiopeiæ is perfectly complementary to this type, and instead of having a dark ray in the position F, it has a luminous band. This may be easily verified by directing the instrument first on to β Cassiopeiæ, which belongs to the ordinary type, and then on to γ Cassiopeiæ. The black band of the first is immediately replaced by the luminous ray of the second. The other exception is β Lyræ. These few exceptions merit earnest attention. If it be true that the black rays are due to absorption by a certain substance (hydrogen in this case), we have here the direct light emitted by this body. A modification of this type is presented by the stars of the constellation Orion (α excepted), which have the common resemblance of fine rays, with one more or less evident in the place of *f*, but having no large bands, and in which the violet lines are very difficult to see. It is remarkable that over the large space occupied by this constellation the observer rarely sees different types from this; this part of space may be said to be occupied by a family of stars which are distinguished from those in the rest of the sky.

A second remarkable type consists of stars having coloured bands in the red and orange. This includes α Orionis, α Tauri, Antaris, β Pegasi, &c. The most remarkable and typical

star of this class is α Herculis. This star gives a spectrum which has the appearance of a series of columns illuminated from one side; the stereoscopic effect of the convexity of these bands due to the shading is so surprising that it cannot be beheld without astonishment. The star δ^2 Lyræ has a similar appearance; only, instead of having convex, it has concave columns. The third type consists of stars with fine lines; it includes Arcturus, Capella, Pollux, &c., and also our own sun. The author says that the spectra of these stars perfectly resemble that of the sun, with fine lines in the same places. In these stars are seen the principal solar rays B, D, *b*, E, F, G, and a great many secondary rays. The author concludes his paper with several theoretical reflections on these remarkable phenomena, and gives a list of the principal stars of each type. In a supplementary note he enters into more detail concerning the spectrum of α Herculis, and gives a drawing of the curious columnar appearance.

"*On the Cases of Cholera which occurred at Marseilles before the Arrival of the Pilgrims from Mecca in 1865*," by M. Grimaud de Caux.

"*On the Discovery of Ancient Monuments in one of the Islands of the Bay of Santorin*," by M. de Cigalla.

"*Remarks on some Rays of the Solar Spectrum*," by M. A. J. Angström. The author considers that the rays A and B, which Janssen says are due to the vapour of water, are not so caused, although he admits they are telluric rays. In support of this view he relies upon the fact that on observing the spectrum at Upsal, when the temperature was 27° below the centigrade zero, most of the telluric rays disappeared, whilst the groups A and B, and a third, called by Brewster *c*, were as strong as ever. The origin of these rays is therefore considered not to be due to the vapour of water, but to a gas, probably carbonic acid.

The author has compared the solar spectrum with one formed by two iron electrodes with a battery of fifty elements, and has found more than 460 rays corresponding to the lines of iron; and, starting from this observation, he draws some comparisons between the metallic spectra produced by a Ruhmkorff's machine, and a battery of fifty elements. Two observations which the author has made are of interest; one is the certain presence of manganese in the sun, proved by the coincidence of nearly thirty lines, and the other is the discovery of a new ray of hydrogen situated nearly halfway between G and H, and which M. Angström calls *h*. This ray can be seen in Geissler's tubes.

"*Discovery of a New Planet of the 11th Magnitude, named Antiope*," by M. Robert Luther.

NOTICES OF PATENTS.

No. 341. *Red Dye*. J. Holliday. Dated February 3, 1866.

This improvement relates to the production of red colouring matter, or dye, by the use of nitro-naphthaline, binitronaphthaline, or trinitronaphthaline, with a salt of aniline or its homologues; preferring the hydrochlorate of aniline of a high boiling point or the hydrochlorate of toluidine. In carrying out the invention, mix about twenty parts, by weight, of hydrochloric acid of commerce with twenty parts of toluidine and ten of nitronaphthaline. Heat this mixture up to 440° F., or thereabouts, until the red dye, or colour, is formed in a somewhat bronze mass. Purify the dye by ordinary processes. This also received provisional protection only.

No. 394. *Composition for Preserving Metals, Wood, &c.* Henry Edward Francis de Briou, M.D., Middlesex. Dated February 8, 1866.

This invention has for its object improved compositions for preserving metals from oxidation, corrosion, and galvanic action; for protecting metals used in the construction of ships against the destructive effects of sea water and preventing their fouling; for protecting wood from the attacks of animalcula, and preserving wood from damp, rot, and decay; for excluding damp from walls, and for use in submarine and other telegraphy.

The patentee takes a composition made with vulcanised india-rubber, such as is described in the specification of a former patent granted to him, and dated July 19, 1864, No. 1804, or made in accordance with a part of the present invention by the substitution of vegetable pitch or resin for mineral pitch, and he renders the composition fluid or semi-fluid by compounding it with bisulphide of carbon. In preparing such a composition proceed as follows:— Take, say, 66 pounds of vulcanised india-rubber and cut it into small pieces, then place it in a large open kettle, by preference of copper, and heat it by a fire underneath; the contents of the kettle are constantly stirred until all the india-rubber is reduced to a liquid state, and care is constantly taken not to apply more heat than is necessary; this will be about 360° Fahrenheit; then add 20 lbs. of vegetable pitch or asphaltum, and continue the heat and the stirring until it is melted and thoroughly mixed; afterwards add 10 lbs. of shellac and 10 lbs. of common resin, and in a similar manner incorporate these with the other ingredients. These operations will require usually from three to six hours, according to the quantity operated on. The contents of the kettle should be carefully stirred the whole time; then the fire is withdrawn, and the composition is poured or ladled out into wooden or metal vessels to cool and harden. The composition thus prepared is rendered fluid, so that it can be used without the aid of heat, by means of bisulphide of carbon. Place it in closely-stopped vessels, together with bisulphide of carbon in the proportion conveniently of 5 lbs. of composition to one gallon of bisulphide of carbon; the vessels should be shaken and turned about daily for eight or ten days, by which time the composition will be completely dissolved and fit for use as a paint and otherwise. To spread the paint over the surfaces to be protected, use common painters' brushes. The paint, which is kept ready for use in large tin jars hermetically closed, is poured out into paint pots such as are used by painters in small quantities at a time, and spread at once to prevent the evaporation of the bisulphide of carbon and the consequent thickening of the paints. Two coats are necessary for ships' bottoms and other submerged substances, and when it is used for ships' bottoms poisonous compounds are incorporated with the outer coating as hereinafter specified. For objects exposed to atmospheric influences the paint should be used more liquid. It is thinned by the addition of a proportion of bisulphide of carbon, which varies according to the degree of consistence required in the paint. For delicate artistic iron works or castings in metals and alloys the paint must be very thin; a single coat is sufficient, but a varnish should be spread over it. Upon submerged wood the paint is applied of the same consistence and prepared in the same manner as for ships' bottoms. For timber left exposed to the air or employed for building purposes or upon railways, the paint ought to be thinner in order better to penetrate the pores of the wood—one coat is sufficient. For submerged wood two coats are used. Brick or stone walls can be covered on one or both sides, one or two coats of the paint being employed. Felt used under the copper sheathing of ships, for roofing, or other purposes, is rendered perfectly water-tight by being dipped into the fluid composition and made to pass between two cylinders. Woollen, cotton, silk, or other stuffs, linen, canvas bands of every material, can be rendered waterproof by being coated with the liquid composition. Wrapping paper, cardboard, and other kinds of paper are made waterproof by spreading a thin coat of the paint between two sheets and passing them between hot cylinders. As regards its employ in

submarine and aerial telegraphy, the patentee uses it in submarine cables to form the core which surrounds the conducting wires; he passes the core through semi-fluid cold paint or composition, and then through a die to equalise the coating. He also saturates with the paint in a very liquid condition the inner covering of the core, whether made of hemp or other fibrous material, and the outer covering when a hempen one is used, and he employs it as a paint for the outer covering when this is made of iron wires instead of hemp. In aerial telegraphy he uses it as a liquid paint for saturating narrow bands woven with hemp or other fibrous materials, and he winds them round the conductors in order to effect insulation and to protect the wires.

When it is desired that the composition shall resist the attacks of marine animals, he compounds it with poisonous materials, which prepare as follows:—Take a substance formed by the decomposition of concentrated hydrocyanic acid in dry chlorine (a kind of chloride of cyanogen), to which add cyanide of mercury and the ferrocyanide of copper in equal proportions, thus forming a compound which readily mixes with the vulcanised india-rubber composition. The proportions are—

Hydrocyanic acid and chlorine (chloride of cyanogen)	1 ounce
Chlorocyanide of mercury	2 ounces
Ferrocyanide of copper	2 ounces
Vulcanised india-rubber composition	25 lbs.

These ingredients are to be well stirred together.

This preparation is principally used for copper, zinc, the brasses and alloys. For iron the cyanide of mercury is sometimes replaced by Prussian blue in the proportion of 3 ounces for 25 lbs. of vulcanised india-rubber composition.

For submerged wood, copper, zinc, or iron, mix together—

Arsenite of copper	5 ounces
Bicyanide of mercury	2 ounces
Vulcanised india-rubber composition	25 lbs.

For all except the very roughest work the disgusting odour of the bisulphide of carbon, which is so plentifully used as a solvent, would probably prove an insuperable barrier to the use of this composition.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W. C.

2418. C. Crump, Southcombe, Paignton, Devonshire, "Improvements in solvents for resins and resinous substances, caoutchouc, gutta-percha, oils, and fats."—Petition recorded Sept. 20, 1866.

2450. A. F. Stoddard, Glasgow, N.B., "A new or improved fuel."

2452. J. Calvert, Strand, "Improvements in the treatment and manufacture of iron and steel."—Sept. 24, 1866.

2460. W. Cormack, Commercial Road, Middlesex, "Improvements in means and apparatus for effecting the revivification of animal charcoal."

2472. J. J. Lundy, Leith, N.B., "Improvements in the treatment of the residues resulting from, and obtained in, the purification and distillation of mineral oils, for the purpose of utilising the same."

2476. H. Aydon and G. B. Jerram, Queen Street, Westminster, "Improvements in furnaces and in the method and apparatus for supplying such furnaces with fuel or other combustible matters."—Sept. 25, 1866.

2494. J. Burgum, Birmingham, "Improvements in puddling and heating furnaces, and other furnaces used in the manufacture of iron and steel."

2496. A. V. Newton, Chancery Lane, "An improvement in the process of distilling petroleum and other oils."—A communication from O. Lugo and T. O. L. Schrader, New York, U.S.A.—Sept. 27, 1866.

2534. D. Barker, Northfleet, Kent, "Improvements in the manufacture of artificial fuel."—Oct. 3, 1866.

2525. P. R. Hodge, Cannon Street, London, "Certain improvements in apparatus for the filtration of fluids."—Oct. 1, 1866.

Notices to Proceed.

1564. A. Parkes, Birmingham, "Improvements in the manufacture of compounds in the nature of kamptulicon."—Petition recorded June 6, 1866.

1593. S. Lees, Salford, Lancashire, "Improvements in furnaces for consuming petroleum and other hydrocarbons."

1594. T. J. Leigh, Denmark Street, Camberwell, Surrey, "Improvements in the method of burning coals (whether large or small coals), coal dust, coke, coke dust, charcoal, wood, and other combustible substances, as also hydrocarbons and gases, and in the arrangement of the furnaces applicable thereto."—June 12, 1866.

1623. W. Knaggs, Euston Square, Middlesex, "Improvements in the manufacture of sugar, and in the apparatus employed therein."—June 14, 1866.

1778. C. Doughty, Lincoln, "Improvements in apparatus for distilling the grease of cotton seed, oil, and other fatty matters."—July 4, 1866.

2413. C. W. Siemens, Westminster, "Improvements in smelting ores, and in furnaces to be employed for that purpose."—Sept. 20, 1866.

CORRESPONDENCE.

Phosphorescent Light.

To the Editor of the Chemical News.

Sir,—I should be interested to have an explanation of the cause or causes of the following phenomenon which I observed one night lately. In my bedroom there is, among other chemicals, a bottle containing ordinary phosphorus under water in the usual way. Without being in the slightest degree shaken or warmed, the air in the upper part of the bottle emits a bright phosphorescent glow of light at regular intervals of about ten minutes, lasting one or two seconds. There is no light whatever apparent excepting at these moments.

I am, &c. A. W. W.

Ulverstone, October 22.

ANSWERS TO CORRESPONDENTS.

General Index to the First Fourteen Volumes of the Chemical News.—We have had an inquiry for such an Index. Its compilation will be attended with considerable trouble and expense; if, however, we find our readers generally wish for one, it shall be commenced as soon as the present volume is completed. Intending subscribers will please notify their wishes to the publisher without delay.

W.—We have sent a reply by post.

A Student.—Your best plan will be to apply to the Secretary of the Chemical Society, Burlington House.

Metallurgist.—By all means avoid the use of mineral acids as far as possible when arranging materials for a blowpipe tour.

J. A.—If our correspondent will send his address, we will communicate with him.

A Parent.—We would rather not take the responsibility of advising on such a subject.

E. C.—In the spectroscope protochloride of manganese gives four green and one large orange ray. Borax gives several green rays, but no orange.

F. J. Smith.—The mineral is most likely pickeringite, an analysis of which was given by Dr. Hewe at page 233 of our seventh volume.

W. Skey, Wellington.—We have to thank our correspondent for a series of seven papers which have just come to hand from New Zealand. Their publication will be commenced immediately. We shall be glad to receive the other communications mentioned in our correspondent's letter.

Toxicologist.—You will probably be able to purify the sulphuric acid from arsenic by converting the latter into arsenic acid, by adding a little bichromate of potash, and then distilling. Arsenious acid is volatile with the vapour of sulphuric acid, but arsenic acid appears to be fixed. For further particulars see a paper by Mr. Lyte in our ninth volume, page 98.

Received.—C. Crump; S. H. J.; W. B. G.

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AND

Journal of Physical Science.

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ROYAL POLYTECHNIC.—Professor PEPPER will, on Tuesday, Nov. 6th, 1866, at 8 p.m., DELIVER a NEW LECTURE on Professor Tyndall's RESEARCHES in HEAT, and exhibit some remarkable experiments, illustrating "Combustion by Invisible Rays," in addition to the present entertainments. Open from 12 till 5 and 7 till 10. Admission 1s.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

New Researches on the Law of Chemical Proportions, and on Atomic Weights and their Mutual Relations, by J. S. Stas.*

(Continued from page 88.)

If the observations which I have just presented are correct, the demonstration of the hypothesis, which must rest with him who asserts it to be a law of nature, will be the more difficult to accomplish in proportion as the unit becomes still more diminished. Chemists who lower this unit, in proportion as exact experiment proves the slight foundation of their proposed unit, find themselves strangely mistaken in the results of the principles which they lay down.

But I acknowledge that all the objections which may be raised against Prout's law cannot replace the rigorous demonstration of the law of definite proportions, which is incumbent upon those, who rely upon it to declare the hypothesis of the English chemist unfounded. The objection of M. Marignac, who questions if the compound bodies contain their elements in the rigorous proportions of their atomic weights, continues then in all its force, and maintains the weight which the authority of his name gives it. It follows from all that goes before, that the problem which I have tried to solve is not susceptible of a strict solution, until I have proved by new experiments that the law of definite proportions is the expression of a mathematical relation.

These considerations have led me to attempt a rigid demonstration of this law, however difficult, and at first inaccessible, the problem may have appeared to me. As it is generally understood, it consists of two natural distinct truths, although the one, properly speaking, is only the consequence of the other. These truths are, the constancy of composition of every combination, and the invariability of the proportions in weight of the elements forming all combinations. Although, to my mind, there remains no doubt of the fixed composition of chemical combinations, I have nevertheless sought to discover whether the composition of the bodies called *stable* is not, *in a very narrow limit*, a function of the conditions under which the combinations are formed—such as *temperature* and *pressure*. I have thus approached the problem of the law in all its generality. On considering it attentively, we perceive that its solution may be arrived at by two different means—by the direct way, and by the indirect way, which at once solves the question of the law of definite proportions, and that of Prout's hypothesis. I understand by the direct way, that by which it is shown that the relation of weight, which all bodies preserve when uniting one to one, two to two, &c., remains invariable.

In the first of these memoirs, entitled "*New Researches on the Laws of Chemical Proportions*," are recorded the experiments which I tried in order to solve these important problems. This consists of two parts. The first has for its title "*On the Constancy of Composition of the Combinations called Stable.*" With a view of settling the question whether, at the time of the formation of compound bodies, pressure or temperature exercise an influence on the relations which the elements constituting them preserve between themselves, I have resumed the determination of the proportional relation between silver and chloride of ammonium, which has already been the subject of such long investigations on my part. I have selected this method because it enables me sometimes to bring in temperature, sometimes pressure, as the condition of formation, and also because the operation can be executed with a precision bordering on mathematical exactness. The results at which I have arrived prove that in the limit to which I was obliged to confine myself to render the experiment possible, *temperature exercises no influence on the composition of chloride of ammonium or chloride of silver; and that pressure is without any influence on the composition of chloride of ammonium.* Indeed, the proportional relation between chloride of ammonium and silver is represented by a constant, whatever may be the mode in which ammoniac chloride and argentic chloride are formed. The second part of this memoir is entitled, "*On the Invariability of the Relations by Weight of the Elements forming Chemical Combinations.*" In order to solve this problem, I have tried to discover if, in binary and ternary bodies, having each *two common elements*, these common elements invariably exist in the same relations by weight—or, in other words, if in two bodies AB and ABC, the relations by weight between A and B are exactly the same in AB as in ABC.

For this purpose I have instituted three series of researches; the results to which they have led me are contained in three notices, entitled:—1st. *Researches on the transformation of iodate of silver into iodide under the influence of sulphurous acid, made for the purpose of proving if the relation by weight between the iodine and silver is the same in these two bodies;* 2nd. *Researches on the transformation of bromate of silver into bromide under the influence of sulphurous acid, made for the purpose of proving if the relation of bromine to silver is the same in the two bodies;* 3rd. *Researches on the transformation of chlorate of silver into chloride, under the influence of sulphurous acid, made for the purpose of proving whether the relation by weight of chlorine to silver is the same in these two bodies.* It follows from these three series of investigations that, under the influence of sulphurous acid, iodate, bromate, and chlorate of silver, *produced under the normal conditions of their formation, can be reduced to the state of iodide, bromide, and chloride without a fraction, however small, of iodine, bromine, chlorine, or silver becoming liberated.* The invariability of the respective weights of the elements constituting these compounds has thus been proved.

It necessarily follows from the combinations of the two orders of facts which I have just tried to establish, that bodies unite in absolutely fixed and invariable proportions—that these proportions are true constants—and that the laws of chemical proportions which have served as an experimental ground-work to the *atomic theory* are mathematical laws, as chemists have admitted for almost half a century.

The legitimate conclusion which may be deduced from it is, then, that compounds produced under the normal conditions of their formation must *necessarily* contain their *simple* elements in the rigid proportions of these constants. These researches, which have been carried out in a most laborious and accurate manner, authorise me to say that the doubt raised by M. Marignac on the subject of the synthesis of nitrate and of sulphide of silver has no foundation in principle, and the objections that the celebrated Genevese chemist has deduced from it are as unfounded as the doubt itself.

I said before that the law of definite proportions might be demonstrated in an indirect way. By this I mean the way which consists in trying whether the atomic weight

* *Memoirs of the Royal Academy of Belgium.*

of the same body remains invariable, when it is determined not only by the aid of independent methods, but by means of different bodies. Indeed, the atomic weights determined under these conditions can only be identical, provided there is invariability between the relation by weight of the elements of the combinations—that is to say, provided the law of chemical proportions is not a limited one. Although it might be proved *à priori* that the indirect way cannot lead to a rigorous demonstration, I have nevertheless attempted it, because it contains in itself the solution of Prout's hypothesis, which has been the aim of my work.

(To be continued.)

Formation of a Substance resembling Artificial Tannin from Coal, by William Skey, *Analyst to the Geological Survey of New Zealand.*

When either bituminous coal or lignite is heated with nitric acid for some considerable time, and then the whole evaporated to dryness, a dark brown substance is left, a large portion of which is soluble in water, and the more readily when heated with it.

The substance thus dissolved by the water has a bitter and somewhat astringent taste, and it readily precipitates gelatine and albumen from their aqueous solution.

Both the soluble and insoluble portions are readily soluble in alcohol and ether, in caustic or carbonated alkali, and also in concentrated sulphuric acid, forming therewith a dark red solution, and from which the part insoluble in water is reprecipitated by dilution; and, further, they appear to contain the elements of nitric acid, as manifested by chemical tests, and by their behaviour on ignition, their combustion being very rapid and complete, accompanied with a slight explosion.

These reactions would seem to indicate that, by the action of nitric acid upon coal, substances are produced analogous to the artificial tannin and picric acid obtained by the action of the same acid upon resin, and therefore distinct from the humic acid series of compounds produced from coal by the application of alkaline agents, with which, I apprehend, they have been confounded.

If, therefore, artificial tannin should ever be used in the manufacture of leather as a substitute for natural tannin as existing in barks, &c.; in lignite, which best admits of the operation above described (by reason of its permeability to liquids), an abundant source of this material is open to us.

TECHNICAL CHEMISTRY.

The Smoke Question, by* P. Spence, *Esq., F.C.S.*

That smoke, in every form of it with which we are acquainted, is a nuisance, I need not attempt to prove. That it is disagreeable to the eyes, painful to more than one sense when it supplants pure air to the breathing organs, that it surrounds us with filth in a form from which we cannot escape, and that, as a result of all these things, it is, *per se*, detrimental to comfort and to a certain extent pernicious to health, I am not going to deny. That, however, the black smoke of our manufacturing operations is, as one would naturally imagine from the continuous outcry made against it, the worst form of the evil—that, in fact, it is, all things duly considered, an evil at all in a sanitary point of view, I am here point-blank to deny; and as I have for years made it the subject of thought and investigation, I think I shall be able to substantiate my opinion.

If in getting rid of black or visible smoke we were to get rid at the same time of the products of combustion altogether, no doubt it would be an immense advantage; but if by getting rid of visible smoke we only increase the quantity and intensify the power of the substances produced in their evil effect on vegetation and animal life, then the benefit is not apparent; and if by getting rid of visible smoke we merely get rid of a body not only inert for evil, but in other circumstances fully allowed to be a body of a health-producing character, then we not only do no good, we do positive harm.

In the discussion on this subject I shall take it that the smoke nuisance means the black smoke produced in our manufacturing processes by the imperfect combustion of coal. Those who speak of doing away with the smoke nuisance have generally very indefinite ideas of the subject. They do not mean, of course, to annihilate the gases resulting from the combustion of coal, neither do they mean to remove these; they mean only that the visible results should be exchanged for the invisible, the seen for the unseen, and this, they seem to think, is doing away with the nuisance. Then what are the visible results of imperfect combustion, and what are the invisible results of perfect combustion, of coal? I cannot enter here upon the theory of perfect and imperfect combustion of coal, but shall merely say the visible substance in the black smoke from our furnace chimneys is nearly pure carbon, and that the invisible results, when combustion is perfect, are carbonic acid gas, nitrogen gas, and sulphurous acid. These gases are all thoroughly poisonous to animal life, and one of them destructive to vegetation. Now carbon, especially in a newly precipitated form, is not only a harmless body—a dirty one, I allow—but it is one of the most powerful disinfectants known. The most fetid and noxious gaseous emanations from our sewers, if passed through a layer of two or three inches of fresh charcoal—which is merely newly precipitated carbon—are rendered perfectly sweet and harmless. Then the carbon in the form of soot diffused is just in the best form to act as a precipitant or oxidising agent on any diffused miasmatic bodies on which it is capable of acting, and its bad effects are merely mechanical ones; it darkens our skin and it soils our linen. Its good effects are not acknowledged, but it seems impossible that so much carbon can float in the air without a purifying effect on miasma, with which it wages deadly warfare whenever they are brought into contact.

Now, what are the invisible results of perfect combustion? You consume in Manchester and Salford some 50,000 tons of coal per week; your coal contains 80 per cent. carbon, and as 6 carbon gives 22 carbonic acid, you get 183,000 tons carbonic acid on an average per week. Your coal contains also 2 per cent. of sulphur, or you have 1000 tons per week sent into your atmosphere. At present a large part of that is precipitated in a solid form in your black smoke; when you get perfect combustion it will all go as sulphurous acid, rapidly becoming sulphuric acid; 1 ton sulphur produces 3 tons of the strongest oil of vitriol, so that you will have, with perfect combustion, 3000 tons per week, or about 500 tons per day, of oil of vitriol poured over your town and neighbourhood.

Now take the town of Swansea. In that town some 2000 tons of copper ore are weekly smelted, and hitherto

* Read before the Social Science Congress, Manchester meeting, on the occasion of the discussion—"How far are smoke and the products of combustion arising from various manufacturing processes injurious to health?" "What measures ought to be taken to prevent the contamination of the atmosphere from such causes?"

all its sulphur converted into sulphurous acid and sent into the atmosphere. But the copper ore contains 25 per cent. of sulphur, and there is therefore only 500 tons of sulphur, or half your quantity, sent out; yet, for a radius of, say, two miles on all sides of Swansea, the land is as bare as a board, and not a green leaf or a living twig is to be seen. When you get perfect combustion of coal in Manchester, I cannot see how the throwing out into the atmosphere here of 3000 tons of sulphurous acid per week will be less destructive to vegetation than 1500 tons per week is at present in Swansea.

But it may be said that theoretically it may appear that black smoke is not pernicious, but practically every one knows that it is detrimental to health. Now here again I believe the sanitary smoke consumers are mistaken. No doubt our towns are unhealthy, much more so, I believe, than they may be made were the zeal and efforts now so largely developed turned into a right direction; but, if you are following an *ignis fatuus*, you may spend all your zeal and strength in running it down, and only find at last that you have got into a mire.

There is only one mode that seems likely to afford us just data for judging whether black smoke is unhealthful—that is, to compare towns that are in most other respects similar, and only or chiefly differ as to the existence or degree of black smoke with which they are surrounded. Let us, then, take for this purpose the four boroughs or towns I shall now name, and in the relative position that I now put them—Liverpool, Manchester, Salford, and Sheffield. Liverpool we may take as a town free from black smoke, as it has no manufactories, and the smoke proceeding from steamers on the river is only transient, and can have little permanent effect. For the consolation of the denizens of Manchester, I should put it next on the list as having a tolerably liberal share of the article, but by no means one of the worst places in that respect, as tall chimneys are spread so well that at few points is there much concentration of the smoke. Salford, I believe, in proportion to its population, has a larger share of large coal-consuming works, and they are also concentrated into masses, giving more density to the supposed evil. But the fourth in my list is *par excellence* a smoky town, as every one who has passed through Sheffield will allow, and there black smoke is not an unavoidable accident, but a necessary incident of the staple industry of the place. A friend of mine, largely interested in its trade, informs me that in Sheffield they find they cannot make good steel unless they make abundance of black smoke; and I must at least give them credit for success in the production of the latter. If our sanitary friends are right in their theory of the unhealthiness of black smoke, we ought to find the death-rate of these towns to ascend in some proportion to the amount of black smoke with which they are severally afflicted, modified, of course, by any peculiar causes of mortality that may affect any one of these towns more than the others. I am not aware of any cause of increased mortality special to Liverpool, Salford, or Manchester. The industry of Sheffield is, however, fairly chargeable with shortening the lives of its workers; steel tool and instrument grinding is so unhealthy that the workers in large numbers fall an early prey to pulmonary disease. Taking these things with us, we ought to find that, assuming the death-rate of Liverpool as a basis, that of Manchester ought to increase in proportion to its amount of black smoke, the increase in the death-rate becoming to some extent an indication or measure of its fatality. Salford, as being somewhat more smoky than Manchester, should give a slightly increased rise in its death-rate, and Sheffield with its maximum, shall I say, of black smoke, and its added unhealthiness of occupation, should give a marked rise in its death-rate, and be by much the highest in the list. I am not aware that the matter can be more fairly put if we are, on this question, to reason from facts as well as from theory; and as the chief fact—namely, the death-rate—will be undisputed, I do not see how we can avoid the conclusions to which, as now placed, they lead us. Now the average death-rate of Liverpool is 44 per thousand annually. Manchester, with its black smoke moderately developed, must then slightly exceed this number. Its average annual death-rate is, however, really 33 per thousand. Salford by the theory must, to a somewhat larger extent, exceed 44; but its actual death-rate for three years' average is under 28 per thousand. But Sheffield must rise the highest, if black smoke and steel filings concur in their deadly effects, and here we ought to have a death-rate of 50 to 60 per thousand annually, at the least. Its death-rate actually is only 27 per thousand, or the lowest on the list. Thus the facts are decidedly in the inverse ratio of the theory of the sanitary smoke consumers, but harmonise completely with what I believe to be true theory, founded on a consideration of the nature and ordinary effects of the body with which we are dealing. Would it not be well, therefore, for our sanitary friends to leave this matter to the economists? While we have nothing to gain on the score of health by consuming our smoke, and may have something to lose, we have much to gain in the economy of our fuel. At present we get not much, if anything, over half the available heat; and as Professor Jevons has sounded the warning note of our coal supply being limited, and as there is a probability of that limit telling at a comparatively early period upon its price, there is an increasing inducement to get perfect combustion as the chief means to get all possible economic results, but in a sanitary sense that will come soon enough. Black smoke will not be abated to any great extent till it can be done economically, and by bringing the law to your aid, you only compel the manufacturer to take up the first patent nostrum that is forced upon his distracted attention, and which, as soon as your legal fangs are removed, he throws up in disgust, whereas, if you give him time, his own interest is constantly pressing him to adopt any proved means of getting all he can out of his coal, and to do this he must first get perfect combustion, and so consume his smoke, in your sense of smoke consumption, but which I forewarn you will be found to be a great increase of the smoke nuisance.

PROCEEDINGS OF SOCIETIES.

ROYAL SCHOOL OF MINES, MUSEUM OF PRACTICAL GEOLOGY.

A Course of Twelve Lectures on Chemical Geology, by Dr. Percy, F.R.S.

Lecture No. X.

Before proceeding with the subject of this morning's lecture, I will draw your attention to an experiment of Daubrée concerning the production of coal—that variety which has been termed anthracite. He took fragments of fir wood, and heated them in a close tube with water at a high temperature, and consequently at a high pressure. He tells us that the wood was transformed by this process into a black mass having a bright lustre. It was perfectly compact, and, in fact, was a mass resembling pure

anthracite. I do not know whether this experiment has been repeated: at all events, it is well worthy of further attention on the part of chemists and others. It has long been supposed that bituminous coal is converted into anthracite simply by the application of heat; but something more than this is required to satisfy the conditions, I am certain, for if it were simply a matter of heat, we ought to get not anthracite, but coke, and we ought to get also a proportionate increase in the quantity of fixed inorganic matter, or ash, in the coal. Thus, if I take a piece of bituminous coal which contains a certain amount of ash, say 5 per cent., and convert it into anthracite by exposing it to heat so as to dissipate a certain amount of volatile matter, or so-called bituminous matter, then the residue ought to contain a much larger proportion of ash, of course, than the bituminous coal upon which we have made the experiment; but in certain varieties of anthracite that assuredly is not the fact. We find some anthracites containing only a very small proportion of ash. Well, now, in this case it is clear that the anthracite cannot be the result of direct igneous action. I do not mean to assert this as a general rule, but if we establish the fact even in a few instances, it is sufficient to prove to us that there must have been some other condition obtaining, in order to account for the conversion of bituminous coal into anthracite. Now, what is that other possible condition? Well, it seems to me exceedingly probable, and to others also, though we are not in a position to establish it with certainty, that hot water has played an important part in this conversion—that the anthracite has been the result of thermo-hydric or hydrothermic action, and that the water has in some way or other removed to a large extent the inorganic matter, or ash. If water will make this change, as we believe it will, we get a clue to the mode in which coal has been formed—I do not say in every case, but in many. If, as Daubrée tells us, hot water converts wood into anthracite, *a fortiori* it will convert wood into bituminous coal.

We will pass on now to the consideration of diamond. I began on the last occasion to describe the physical properties of diamond. What we have to consider especially is the knowledge we have concerning the conditions under which diamond occurs in nature. It is a subject which has excited very great attention heretofore, and still occupies the attention of chemists and others; but, unhappily, so far all attempts to produce the diamond have been unsatisfactory in their results.

The diamond, undoubtedly, is one of the most beautiful gems in nature, as we are all prepared to admit. It crystallises in the cubical system—either as a regular octahedron, or in some form of the cube—the dodecahedron, and so on.

Now, there are many points concerning diamonds, which we observe in different specimens, calculated to throw some light, at all events, upon the subject of their formation. We have black diamonds; we have diamonds which have all the physical properties of the diamond save that of transparency; they are black and coke-like; they possess the crystalline structure of the diamond and the hardness of the diamond, and will cut glass like it. It is perfectly certain that ordinary diamonds cannot have been the result of exposure to a high temperature, for this reason: if we take an ordinary diamond and heat it strongly, we render it opaque and convert it into a coke-like mass. That settles the point of high temperature, I think, definitely.

Now, with regard to the matters included in diamonds. This is a subject which has received great attention, but much further information is required before we can arrive at anything like satisfactory conclusions. It has been said that crystals of gold have been found enclosed in diamonds. That, I believe, is a mistake, and that what has been supposed to be gold has, in reality, been another crystal of diamond. Now, if we had found a crystal of gold in diamond, or some readily fusible matter like gold, it is perfectly evident then that we get an indication as to temperature, and we should be justified from such an observation in concluding that the diamond could not have been the result of high temperature. Then, again, it has been asserted that iron pyrites has been found in diamonds, but that assertion requires further proof. It would be really a most important point to establish, as it would furnish a decided clue as to the mode of formation of diamond—or I ought to speak with rather more caution, and say it possibly might do so.

The diamond has often been made the subject of investigation by burning. Many a diamond has been burned in oxygen gas. Although it consists of pure carbon, yet it ignites with great difficulty under ordinary conditions. Still we can burn it, and convert it completely into carbonic acid by exposing it to a sufficiently high temperature in oxygen gas; and even, of late, experiments have been made with the diamond with regard to the production of steel. It has been found that diamond is capable of converting pure iron into steel, just as carbon in any other form produces steel. Take a piece of diamond, place it on a piece of iron, and heat them together in oxygen gas—not to a very high temperature; the diamond drills a hole in the iron, and forms a readily fusible compound of carbon and iron. Now, as to the results of the combustion of diamond, specially with regard to the residue which is left after such combustion—for that is the point which most concerns us. It appears that after such burning a little incombustible residue is left, which is described by some as a spongy network having a reddish-yellow colour at some times, as being at other times in the form of crystalline straw-coloured particles, and at other times as colourless and consisting, it is asserted, of crystalline fragments. Similar residues have been obtained from large diamonds and very carefully examined. This residue contains, we are informed, both silica and iron, and some have also asserted that an organic structure is to be found in this residue; but that is a point which requires further confirmation before we receive it as settled. If we could establish that point of organic structure in this residue, then, I think, we should be justified in coming to a conclusion that diamond must have been the result of some organic process, as is now supposed by a great many persons.

Let us next glance at the mode of occurrence of diamond in nature, and I will pass over this part of our subject as briefly as I possibly can. It is one of considerable interest.

Diamond occurs in a rock which is called itacolumite, from Itacolumi, the name of a town. It is nothing more than a quartzose rock. We have very fine specimens illustrating this point in the museum above. Itacolumite occurs in Brazil and elsewhere. We shall be struck with the remarkable similarity of the conditions under which diamond is found in different parts of the world. Itacolumite is a sort of sandstone which is soluble, granular, and very friable. It often contains talc, chlorite, and mica. It generally has a schistose or slate-like structure, and sometimes it is more or less flexible. It is said that hornblende is sometimes found in the schist accompanying this itacolumite. A paper on the occurrence of diamonds in South America was written a short time ago (in the year 1860), a translation of which is to be found in the *Annales des Mines* of that date. The paper is a very interesting one respecting the present important inquiry concerning the antiquity of man. The writer says, "A very curious fact is the discovery in the cascalho"—that is, the stuff in which the diamond is found—"of small fragments of quartz having the form of an anvil." These are evidently the work of human hands. They are very small, and they are supposed to have been used as ornaments. "They have been polished, and have no doubt," he says, "been made by the Indians, to whom they served as earrings." Then the paper states, "The cascalho in

which they have been found had not been previously worked in historical times, and formed the bed of a river almost entirely dried up. It was found covered with more than six metres of vegetable soil"—nearly 19 feet—"on which had grown many magnificent palm trees." The authors go on to tell us that the polished cut quartz articles were accompanied by other articles, such as arrow points. There were also bones, and they conclude that these remains demonstrate very great antiquity with regard to man. I called attention to this subject last year. I do not know whether any further investigation has been made concerning it. It is well worthy of attention on the part of those who are concerned in this most interesting inquiry.

Before we deal with the theories of the production of the diamond, I may say that all experiments to make diamond have hitherto failed, and failed most completely. You will find in chemical works at different times processes described whereby carbon has been separated from combination, and obtained in a crystalline form; but all these statements, I believe, are entirely erroneous. There was a statement concerning the action of silver upon bisulphide of carbon, or of phosphorus upon bisulphide of carbon. We were told that the silver would lay hold upon the sulphur and separate the carbon gradually, and that the process required time. I tried this experiment with bisulphide of carbon and silver during ten years, but without success. It is true there was a darkening on the surface of the silver, showing the formation of sulphide of silver, but that arose from the fact that the bisulphide of carbon originally operated upon contained free sulphur. One gentleman especially has devoted much time in attempting to make diamonds, and some time ago I received a very minute quantity of crystalline matter for examination which it was thought might be diamond, but it turned out to contain about 99½ per cent. of silica. This shows how persons may make mistakes as to the results they obtain. Liebig has the notion that diamond is the result of the final natural decay of vegetable matter, but in nature we do not find diamond under those conditions where we observe these final products of natural decay—in our coal fields, for example. Anthracite is one of the final results of this decay; and no one, I believe, has ever found diamond in a coal field, where one ought to find it if it is the result of this final decay. We find graphite in nature, which is a crystalline form of carbon, just where we should expect to find it, but we do not find diamond there. There is nothing like substantial evidence to support Liebig's conclusion. At present it is a mere hypothesis: not one single substantial fact can be urged in support of it, except that which I mentioned a short time ago, if it be a fact—that of the occurrence of organic structure in diamond.

(To be continued.)

BRITISH ASSOCIATION, NOTTINGHAM MEETING.

Friday, August 24.

A Lecture "On the Results of Spectrum Analysis, as applied to the Heavenly Bodies," by William Huggins, *F.R.S.*

(*Continued from page 200.*)

NEBULÆ.

I pass now to objects of another order.

When the eye is aided by a telescope of even moderate power, a large number of faintly luminous patches and spots come forth from the darkness of the sky, which are in strong contrast with the brilliant, but pointlike images of the stars. A few of these objects may be easily discerned to consist of very faint stars closely aggregated together. Many of these strange objects remain, even in the largest telescopes, unresolved into stars, and resemble feebly shining clouds, or masses of phosphorescent haze. During the last 150 years, the intensely important question has been continually before the mind of astronomers, "What is the true nature of these faint comet-like masses?"

The interest connected with an answer to this question has much increased since Sir William Herschel suggested that these objects are portions of the primordial material out of which the existing stars have been fashioned, and further that in these objects we may study some of the stages through which the suns and planets pass in their development from luminous cloud.

The telescope has failed to give any certain information of the nature of the nebulæ. It is true that each successive increase of aperture has resolved more of these objects into bright points, but, at the same time, other fainter nebulæ have been brought into view, and fantastic wisps and diffused patches of light have been seen, which the mind almost refuses to believe can be due to the united glare of innumerable suns still more remote.

Spectrum analysis, if it could be successfully applied to objects so excessively faint, was obviously a method of investigation specially suitable for determining whether any essential physical distinction separates the nebulæ from the stars.

I selected for the first attempt, in August, 1864, one of the class of small but comparatively bright nebulæ.

My surprise was very great, on looking into the small telescope of the spectrum apparatus, to perceive that there was no appearance of a band of coloured light, such as a star would give, but, in place of this, there were three isolated bright lines only.

This observation was sufficient to solve the long-agitated inquiry in reference to this object at least, and to show that it was not a group of stars, but a true nebula.

A spectrum of this character, so far as our knowledge at present extends, can be produced only by light which has emanated from matter in the state of gas. The light of this nebula, therefore, was not emitted from incandescent solid or liquid matter, as is the light of the sun and stars, but from glowing or luminous gas.

It was of importance to learn, if possible, from the position of these bright lines, the chemical nature of the gas or gases of which this nebula consists.

Measures, taken by the micrometer, of the most brilliant of the bright lines, showed that this line occurs in the spectrum very nearly in the position of the brightest of the lines in the spectrum of nitrogen. The experiment was then made of comparing the spectrum of nitrogen directly with the bright lines of the nebula. I found that the brightest of the lines of the nebula coincided with the strongest of the group of lines which are peculiar to nitrogen. It may be, therefore, that the occurrence of this one line only, indicates a form of matter more elementary than nitrogen, and which our analysis has not yet enabled us to detect.

In a similar manner the faintest of the lines was found to coincide with the green line of hydrogen.

The middle line of the three lines which form the spectrum of the nebula, does not coincide with a very strong line in the spectra of about thirty of the terrestrial elements. It is not far from the line of barium, but it does not coincide with it. Besides these bright lines there was also an exceedingly faint continuous spectrum. The spectrum had no apparent breadth, and must therefore have been formed by a minute faint light. Now, this nebula possesses a minute but bright nucleus. We learn from this observation that the matter of the nucleus is almost certainly not in a state of gas, as is the material of the surrounding nebula. It consists of solid matter, which may exist in the form of an incandescent fog of solid or liquid particles.

The new and unexpected results arrived at by the prismatic examination of this nebula, showed the importance of examining as many as possible of these remarkable

bodies. Would all the nebulæ give similar spectra? Especially it was of importance to ascertain whether those nebulæ, which the telescope had certainly resolved into a close aggregation of bright points, would give a spectrum indicating gaseity.

The observation, with the prism, of these objects is extremely difficult on account of their great faintness. Besides this, it is only when the sky is very clear and the moon is absent that the prismatic arrangement of their light is even possible. During the last two years I have examined the spectra of more than sixty nebulæ and clusters. These may be divided into two great groups. One group consists of the nebulæ which give a spectrum similar to the one I have already described, or else of one or two only of the three bright lines. Of the sixty objects examined about one-third belong to the class of gaseous bodies. The light from the remaining forty nebulæ and clusters becomes spread out by the prism into a spectrum which is apparently continuous.

I will exhibit upon the screen diagrams of a few of the more remarkable of the nebulæ which are gaseous in their constitution.

(To be continued.)

ACADEMY OF SCIENCES.

October 22.

At the sitting this day the first communication read was an article

"*On the Theory of Heat according to the Vibratory Hypothesis*," by M. Babinet. The author has gone rather deeply into the mathematics of the question, but he bases his arguments upon one or two observations which are somewhat novel. Thus, it was found by MM. Favre and Silbermann that the decomposition of oxide of silver took place with the loss of a very insignificant amount of heat. They also found that in the decomposition of oxygenated water there is a large evolution of heat, and the same phenomenon is observed in most chemical combinations. M. Babinet has investigated these several phenomena mathematically, and explained them. He then discusses the cause of the evolution of heat in the combustion of sulphur, oxide of carbon, and hydrogen.

"*On the Harmony of the Molecule of Ammoniacal Alum*," by M. Gaudin. Possessing special and exclusive information as to the exact arrangement of the molecules of organic or inorganic chemical compounds, M. Gaudin from time to time enlightens his fellow-chemists on this important subject. In this paper we are informed that the "molecule of ammoniacal alum is composed of an axis of seven atoms, around which are arranged thirty-two linear molecules of three atoms, representing four molecules of sulphurous acid and twenty-eight molecules of water. The axes of seven atoms form three perpendicular lines between them, two by two, where the atoms figure always A between two B, as the rows with three atoms between them to form nets, as the nets between them to form masses, as the masses between them to form the molecule." The author concludes—"From this it must be felt that my system cannot but be true, or I should have found something more beautiful than nature." We have not the least doubt of it.

"*Note on the Employment of a Double Wire Rheometer in Experiments on Radiant Heat*," by M. P. Desains. The author employs a kind of differential apparatus essentially composed of a single source of heat, of two piles, of a double wire rheometer, and finally of a rheostat. The apparatus is so arranged that the equilibrium, once obtained, remains uniform however the heat from the source varies; but if the smallest variation takes place in one of the radiations the needle quits the zero point. The author has applied this apparatus to the examination of the absorption of heat by transparent gases, and finds that it gives very delicate and certain indications.

"*On Coriamyrtin and its Derivatives*," by M. Y. Riban. This is a continuation of a paper read on the 17th of September last. He now assigns to it the formula $C_{30}H_{36}O_{10}$. Bromine and iodine compounds have been prepared and examined, and the action of bases and acids upon it is described.

"*On the Analysis of the Milk of the Cat*," by M. A. Commaille. He finds that this milk affords a very substantial nourishment, rich in albuminoid matters. We trust the hint will not be thrown away upon enterprising physicians of the metropolis, which would afford peculiar facilities for the stocking and maintenance of diminutive dairy farms.

REPORT ON THE

CHEMICAL LABORATORIES

IN COURSE OF ERECTION IN THE

UNIVERSITIES OF BONN AND BERLIN.

The Chemical Laboratories of the Rhenish Friedrick William University of Bonn.

(*Continued from page* 199.)

The Ground Floor.

As this floor had to contain no less than forty-four rooms, exclusive of vestibule, corridors, and closets, its dimensions must necessarily be very considerable. The ground floor (Fig. 2, page 211) is shown on a scale of $\frac{1}{300}$th of the real size, a proportion retained in all the drawings illustrating the Report on the Bonn institution, with the exception only of the plan of situation. The experienced eye will rest with pleasure on the beautiful outlines of the building symmetrically developed in every direction. Four outer wings enclose an area of very considerable size, divided into four quadrangles or courts by a cruciform interior building. Those parts of the edifice surrounding the two back courts are exclusively devoted to the purposes of practical instruction in chemical analysis and research. The wing of the central structure which separates the two front courts from each other includes the lecture theatre, with the rooms pertaining to it; in the south-west side wing of the left front court is the private laboratory of the director, with the rest of the rooms devoted to his use. The corresponding north-east side wing of the right front court is occupied by the apartments of the assistants and other officers. The ground floor of the front part of the building, lastly, is devoted to the scientific collections of the institution and a small theatre for special lectures.

We shall first consider the distribution of space on the ground floor, which, as already stated, constitutes the main part of the building. The several apartments marked by letters are specified by name in the synopsis (page 212), in which the dimensions of each room are likewise given.

The following remarks may assist the reader in understanding the objects for which the various rooms are destined, and their situation with regard to one another:—

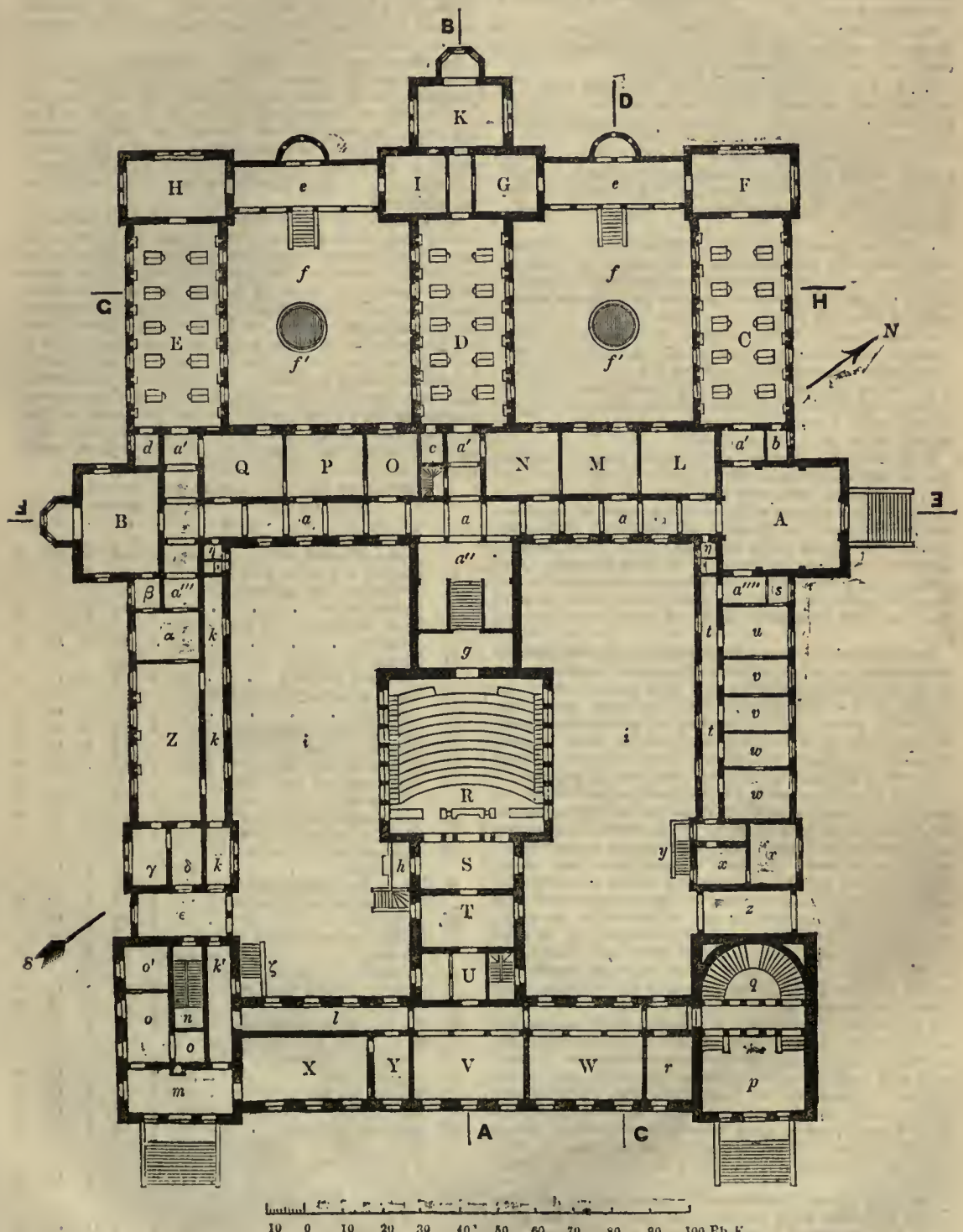
The main entrance for students, as well for those working in the laboratory as for those who only attend the lectures, lies in the principal side-front facing the city of Bonn.

After ascending the massive flight of stairs, we enter the large vestibule (A), the rich architectural decoration of which at once bespeaks the dignity of a great public building dedicated to science. Before the spectator stretches a long corridor (*a a a*) of considerable width, the main artery of the entire building. It is brilliantly lighted by a number of windows* on the left side. The large folding doors at the further end of the corridor, visible from and directly

* These, as well as all other windows facing the courts, are 9 feet in height and 4 feet wide, whilst the external windows of the ground floor are 9 feet high and 4 feet 3 inches wide.

Fig. 2.

Rooms on Ground Floor.



opposite to the main entrance, lead to the director's spacious study (B), which is provided with a large bay-window for microscopic observation; from this central situation the various parts of the great building are quickly and easily accessible.

On the right side the great corridor branches out into three side-corridors (*a'*, *a'*, *a'*), leading to the entrance of the three principal laboratories (C, D, E).

Each of these three laboratories, profusely lighted by ten windows, symmetrically arranged on the two sides, provides twenty students with more than sufficient space and every convenience for work.

Permanent working places for sixty students — the number which, as already mentioned, the institution is to accommodate—were thus secured. According to this disposal of the space, the students range themselves in three classes:—

1. Beginners—that is to say, those who, having become acquainted with the rudiments of chemistry by attending lectures, enter the laboratory to practise chemical manipulation, to make preparations, and to go through an elementary course of qualitative analysis.

2. Advanced students, or those who, having acquired practice in qualitative experiments, are occupied with quantitative analysis, both ponderal and volumetric.

3. Young chemists, sufficiently conversant with the principal departments of the science to engage in original experimental investigations, either suggested by the director or chosen by themselves.

A division of this nature, whereby the three classes are distributed in separate rooms, seemed expedient for more than one reason. Not only was it possible to fit up each laboratory in a manner suitable to the wants of each particular class, but the situation of the rooms themselves could be so adapted to the remaining parts of the building as to offer the greatest facilities to each division. And even greater advantages as regards readier supervision and increased means of maintaining discipline in all parts of the institution were afforded by an arrangement of this kind.

The gond arising from a large number of students working together in an extensive institution is unmistakable. If the student only have his eyes open to the work of his neighbours, he has opportunities of gaining, in a comparatively short time, an amount of experience which, working alone or in company with few, he could scarcely gather during years of diligent labour. The chemical atmosphere in which he breathes promotes his progress.

These advantages, on the other hand, cease when the number of learners exceeds those limits within which personal supervision is possible. Whenever the beginner is conscious that he is unable to procure help at any moment; whenever the more advanced student feels that he no longer receives individual attention; lastly, whenever the young chemist, though working independently, is no longer satisfied that an experienced eye watches over his steps, the chemical institution, however excellently it may be organised in other respects, will yield very indifferent results indeed. It is, therefore, of the first importance for the director of such an institution to have the necessary amount of teaching power at his command. According to the Reporter's experience, it is not possible for an assistant to superintend, for any length of time and with satisfactory results, the labours of more than twenty students. Acting upon this experience, the Minister of Public Instruction decided to appoint for the institutions both of Bonn and Berlin three scientific assistants, who, under the guidance of the director, are to watch over the experimental labours of the students. The disposal of the students in three separate laboratories is in exact accordance with this provision.

Of these three laboratories, all accessible, as has been stated, from the main corridor, the one (C) on the right side of the vestibule is apportioned to the beginners, and will, to avoid unnecessary repetition, be called the First Laboratory; the central one (D) is set apart for advanced students, and will be known as the Second Laboratory; whilst that (E) in the immediate neighbourhood of the director's study will be occupied by young chemists engaged in original investigations, and will be designated as the Third Laboratory.

In these three laboratories the students have their permanent working places. To each one is allotted, for this purpose, a table amply supplied with gas and water, as well as lock-up drawers and cupboards in which to keep apparatus, reagents, &c.—in a word, his entire chemical estate, so to speak. At these working benches, all ordinary chemical work and all operations, not requiring special arrangements provided in other parts of the institution, are carried on.

Considering the great importance of these rooms, a strong temptation presents itself to the Reporter to give here an exhaustive description of their organisation, on which the utmost care has been bestowed. If he resists this temptation, it is partly because the various arrangements, especially the appliances for general ventilation and the tubes for carrying off injurious liquids and gases, though provided for even to the minutest detail, exist as yet only in their first rudiments, and may consequently be still materially modified in the process of completion, and partly because too detailed a description of the internal fittings of each room would prevent his giving a clear general outline of the building as a whole, and more especially of the mutual connexion of its various parts, which after all must be the object of this report.

Synopsis of Rooms on Ground Floor.

	Name of Room.	Length. ft.	Length. in.	Breadth. ft.	Breadth. in.	Height. ft.	Height. in.
A	Vestibule of main entrance on north-east side	29	8	26	6	29	0
B	Director's study, with bay window for microscopic observation	26	6	19	4	15	0
C	First laboratory, for beginners	54	0	22	0	17	0
D	Second laboratory, for advanced students	54	0	22	0	17	0
E	Third laboratory for original research	54	0	22	0	17	0
F	Operation room, laboratory C	25	6	15	0	17	0
G	Operation room, laboratory D	15	0	15	0	17	0
H	Operation room, laboratory E	25	6	15	0	17	0
I	Ante-room of gas analysis laboratory	15	0	15	0	17	0
K	Gas analysis laboratory	22	0	16	0	17	0
L	Room for volumetric analysis	19	2	16	2	15	0
M	Balance-room of second laboratory	19	10	16	2	15	0
N	Room for fusions and ignitions of second laboratory.	19	7	16	2	15	0
O	Library	16	2	13	3	15	0
P	Balance-room of third laboratory	19	10	16	2	15	0
Q	Room for fusions and ignitions of third laboratory	19	7	16	2	15	0
R	Great lecture theatre	40	0	40	0	28	0
S	Lecture preparation room	25	8	12	0	15	6
T	Store-room for apparatus, models, drawings, diagrams, &c.	25	8	13	10	15	6
U	Professor's waiting-room	17	6	12	1	15	6
V	Mineralogical museum	29	5	18	1	15	6
W	Chemical museum	29	5	18	1	15	6
X	Small lecture theatre for recapitulations and special lectures	31	7	18	1	15	6
Y	Waiting and preparation room for small lecture theatre	18	1	8	11	15	6

	Name of Room.	Length. ft.	in.	Breadth. ft.	in.	Height. ft.	in.
Z	Director's private laboratory	40	1	15	11	15	0
a, a, a	Main corridor of institution	144	8	9	0	15	0
a', a', a'	Passages leading to principal laboratories	...		...		...	
a''	Staircase and passage leading to great lecture theatre	25	8	9	0	26	0
a'''	Side passage to director's private laboratory	17	6	9	0	15	0
a''''	Side passage to wing containing assistant's apartments	8	9	9	0	14	0
b	Closets attached to laboratories for apparatus and instruments	7	5	5	8	15	0
c				5	8		
d				5	0		
e, e	Roofed colonnades for open-air work	37	3	10	0	14	0
f, f	Back courts of institution	56	1	46	10		
f', f'	Reservoirs in the back courts (10 feet in diameter)	...		...		...	
g	Landing overlying thoroughfare between the two front courts	29	2	9	0	13	0
h	Platform leading from lecture preparation room down into front court	12	0	5	0		
i, i	Front courts of institution	115	6	45	0		
k, k, k	Corridor of front side wing facing south-west	62	9	4	9	15	0
k'	Prolongation of corridor (*k*) into front block	15	0	6	6	15	0
l	Corridor of front block	41	10	6	3	15	6
m	Vestibule of left main entrance of front façade	27	8	11	9	15	6
n	Side staircase of left main entrance leading to director's residence on first floor	...		...		...	
o, o	Third assistant's apartments	18	4	11	6	15	6
o'	Room belonging to third assistant's apartments	11	9	11	6	15	6
p	Vestibule of right main entrance of front façade	27	8	21	1	15	6
q	Main staircase of right entrance leading to director's residence on first floor	...		...		...	
r	Porter's lodge in main entrance	18	1	11	0	15	6
s	Porter's lodge in main side entrance	7	5	5	8	14	0
t, t	Corridor of front side wing facing north-east	62	9	4	9	14	0
u	Cloak-room	15	11	13	7	14	0
v, v	Castellan's room	15	11	8	2	14	0
w, w	First assistant's apartments	15	11	8	2	14	0
				13	7		
x, x	Second assistant's apartments	12	4	9	5	14	0
				15	0		
y	Staircase leading from right front court to the apartments of assistants and castellan	...		...		...	
z	Carriage way to right front court	25	6	11	0	...	
α	Director's waiting-room	15	11	13	7	15	0
β	Passage connecting director's waiting-room and study	7	5	5	8	15	0
γ	Director's balance-room	15	0	8	5	15	0
δ	Director's fusion, ignition, and combustion room	15	0	8	5	15	0
ε	Director's roofed colonnade for open-air work	22	0	11	0	15	0
ζ	Steps leading from left end of front block down to left front court	...		...		...	
η, η	Closets	7	11	4	9	15	0

Turning now our attention to the side apartments attached to the three laboratories, we have, in the first place, to mention three Closets (*b, c, d*) in direct communication with the main rooms. They are in charge of the respective assistants, and are intended for preserving delicate and costly apparatus, platinum and silver vessels, expensive reagents, everything, in fact, of which special care has to be taken. Two of these closets (*b* and *d*), belonging to the laboratories in the wings of the building, are lighted from the side, the central one (*c*) by means of a skylight.

In the three laboratories the students, as already stated, have their permanent benches allotted to them. Now, though working space has been most liberally provided, and gas and water amply supplied in these rooms, which are, moreover, furnished with every facility for carrying off vapours and liquid products, there are still certain operations which cannot be well conducted in them.

On this account they are connected with a series of rooms devoted to special purposes. There are, in the first place, to be mentioned three rooms (F, G, H) directly communicating with the laboratories, and situated opposite to their main entrances; we will call them, for the sake of distinction, Operation Rooms.

All kinds of work, such as distillations, making of gases, heating of bodies in particular gas-atmospheres—in short, all experiments requiring large and complicated apparatus—are conducted at the benches fitted up in these rooms or in the "evaporation niches" let into their walls. Should, however, on any particular occasion, even more space be required, were it likely that, in spite of the excellent draught of the chimneys, noxious vapours might escape into the rooms, or were, lastly, sulphur compounds to be prepared, like mercaptan or similar substances, the disgusting smell of which would infect the air of the operation rooms and of all the adjoining apartments, provision has likewise been made for such contingencies. Each operation room communicates with a covered Colonnade (*e, e*), opening towards a back court, and fitted up with gas and water and all the requisites for work. From these colonnades, the basement of the building, containing a variety of rooms devoted to the objects of the institution and more especially the metallurgical laboratories, is accessible by means of spiral staircases placed in spacious semicircular projections from the outer walls. Flights of steps, on the other hand, lead from the open sides of the colonnades down to the two Back Courts (*f, f*) lying between the three laboratories, and here the student finds an additional supply of water in the large central Reservoirs (*f', f'*), the tabular parapets of which serve as working benches for a variety of operations. The colonnades afford, moreover, facilities for passing at the back from one laboratory to the other, communication between those three important parts of the institution being thus by no means confined to the large corridor (*a, a, a*) in front.

The three operation rooms, situated behind their respective laboratories, are not of equal dimensions. In apportioning their size, especial attention had to be paid to the wants of the beginner and of the independent worker. The beginner who practises the various forms of chemical manipulation, as preparing gases, making chemical preparations of all kinds, &c., requires ample space. In like manner the young chemist, engaged in actual research, may at any moment have to fit up new or reconstruct old apparatus, often of a complicated nature, for the particular objects of his investigation; tools of the most various description—hammers, files, vices, &c.—are thus constantly required, not to mention the blowpipe-table, which is scarcely ever at rest. For him too it is of vital importance that he should not be cramped in space. For this reason the operation rooms (F and H), connected with the two wing laboratories and expressly intended for the classes just mentioned, are made as large as possible.

The students of the second laboratory, principally occupied with quantitative analysis, for the special operations of which several other places, described below, are provided, have therefore had a less spacious operation room (G) allotted to them. By this arrangement an additional small apartment was gained, symmetrical with the operation room, and serving as approach to a very important part of the institution—viz., the Laboratory for Gas Analysis (K). This spacious apartment, which probably will be divided into several parts, projects from the middle of the building at the back, and is thus almost equally accessible from the three laboratories. It is, on the other hand, sufficiently removed, more especially by the intervening Ante-room (I), from those parts of the building where the chemical business of the institution is most active, to allow of the delicate measurements here made being carried out without disturbance.

The laboratory for gas analysis is lighted by two large side windows and also by three smaller windows situated in a central projection; but all the light coming from the south, already partially intercepted by the third laboratory with its operation room, can be shut out by means of strong well-closing shutters, thus securing to this apartment the uniform temperature so important in gas analysis.

The operation room (G) of the second laboratory, the ante-room (I) to the gas analysis laboratory, and the passage between these two apartments, are lighted by skylights.

(To be continued.)

NOTICES OF BOOKS.

A Description of the new Telescopes with Silvered-glass Specula; and Instructions for adjusting and using them. By John Browning, F.R.A.S., F.M.S., F.M.S.E. London: Straker and Sons.

This is a very useful little book on a subject which is attracting increasing attention amongst men of science. The author is well known by the valuable optical *instruments of precision* which have been issued from his workshops, and we are glad to see that he has now been induced to turn his attention to the grinding and manufacture of silvered-glass reflectors having the proper parabolic curvature.

There are few chemists who have not at one time or another felt the want of a good process for silvering glass surfaces. Many descriptions are to be found in books, but they do not always fulfil the promises made for them by their authors; our readers will, therefore, be glad to preserve for future reference the following excellent description, which we quote from this work:—

"*To Silver Glass Specula.*

"Prepare three standard solutions:—

"*Solution* A.—Crystals of nitrate of silver, 90 grains; distilled water, 4 ounces. Dissolve.

"*Solution* B.—Potassa, pure by alcohol, 1 ounce; distilled water, 25 ounces. Dissolve.

"*Solution* C.—Milk sugar (in powder) ½ ounce; distilled water, 5 ounces. Dissolve.

"Solutions A and B will keep, in stoppered bottles, for any length of time. Solution C must be fresh.

"*The Silvering Fluid.*—To prepare sufficient for silvering an 8-inch speculum:—Pour 2 ounces of solution A into a glass vessel capable of holding 35 ounces. Add, drop by drop, stirring all the time (with a glass rod), as much liquid ammonia as is just necessary to obtain a clear solution of the grey precipitate first thrown down. Add 4 ounces of solution B. The brown-black precipitate formed must be just re-dissolved by the addition of more ammonia, as before. Add distilled water, until the bulk reaches 15 ounces, and add, drop by drop, some of solution A, until a grey precipitate, which does not re-dissolve after stirring for three minutes, is obtained; then add 15 ounces more of distilled water. Set this solution aside to settle. Do not filter. When all is ready for immersing the mirror, add to the silvering solution 2 ounces of solution C, and stir gently and thoroughly. Solution C may be filtered.

"*To Prepare the Speculum.*—Procure a circular block of wood 2 inches thick, and 2 inches less in diameter than the speculum. Into this should be screwed three eye-pins, at equal distances. To these pins fasten stout whipcord, making a secure loop at the top. Melt some pitch in any convenient vessel, and having placed the wooden block face upwards on a level table, pour on it the fluid pitch, and on the pitch place the back of the speculum, having previously moistened it with a thin film of spirit of turpentine, to secure adhesion. Let the whole rest until the pitch is cold.

"*To clean the Speculum.*—Place the speculum, cemented to the circular block, face upwards, on a level table, pour on it a small quantity of strong nitric acid, and rub it gently all over the surface with a brush made by plugging a glass tube with pure cotton wool. Having perfectly cleaned the surface and sides, wash well with common water, and finally with distilled water. Place the speculum face downwards in a dish containing a little rectified spirit of wine, until the silvering fluid is ready.

"*To Immerse the Speculum.*—Take a circular dish about 3 inches deep, and 2 inches larger in diameter than the speculum. Mix in it the silvering solution and the solution C, and suspend the speculum, face downwards, in the liquid, which may rise about ¼ of an inch up the side of the speculum.* When the silvering is completed, remove the speculum from the solution, and immediately wash with plenty of water, using at least 2 gallons, and finally with a little distilled water. Place the speculum on its edge on blotting paper to drain and dry. When perfectly dry, polish the film by gently rubbing, first with a piece of the softest wash-leather, using circular strokes, and finally with the addition of a little finest rouge. A 'flat' may be silvered by fastening with pitch to a slice of cork, cleaning as above described, and using as much silvering fluid as will form a stratum about ⅛ inch deep beneath the mirror."

In addition to the above, the reader will find a clearly written description of reflecting telescopes, mounted on alt-azimuth and equatorial stands, with directions for using and preserving the silver surface of the speculum, and on working glass specula, &c. Not the least interesting part of the book will be found on the last few pages, which contain price-lists of all that can be of interest to the astronomer or man of science in the way of specula, silvered and unsilvered, telescopes mounted and unmounted, together with "perfect planes," prisms, and spectroscopes.

Outline Facts of Chemistry, with Exercises; intended chiefly for Pupils in Government Science Classes. By T. Ward, F.C.S. Parts I. and II. London: Simpkin and Marshall. Manchester: Heywood. 1866.

A notice of the first part of this work appeared in vol. xiii., p. 117, of the Chemical News. The second part, which treats of the metals and their compounds, is now published, and the two are bound together, forming a convenient-sized note-book for the pocket. The new notation is adopted throughout, and tables of the Centigrade and Fahrenheit scales and the French weights and measures are supplied, together with exercises, by means of which the student may test his proficiency. The more important facts are given in larger type for the use of beginners, and a copious index supplies a ready means of reference. We may safely predict a favourable reception for this little book.

* The silvering will be completed in from 50 to 70 minutes, according to temperature; 50 minutes will be found sufficient in summer.

CONTEMPORARY SCIENTIFIC PRESS.

[Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted.]

Annalen der Chemie und Pharmacie. No. 1. July.

"*Researches on Isomerism in the Benzoic Series.*" "*On Amido-benzoic Acid and Amido-dracylic Acid,*" by F. Beilstein and P. Geitner.

"*On the Formation of Glycerine from Trichlorhydrin,*" by E. Linnemann.

"*On the Chemical Constituents and Colouring Matter of some Lichens* (*Rocella fuciformis*, Acharius; *Rocella tinctoria*, De Candolle)," by O. Hesse.

"*On Turpeth Resin,*" by H. Spirgatis.

"*On Crotonic Acid,*" by C. Bulk.

"*On an Improved Gas Combustion Furnace for performing Organic Analyses,*" by E. Erlenmeyer.

"*On an Apparatus for heating Substances enclosed in Sealed Tubes,*" by the same author.

"*On the Products of the Decomposition of certain Resins by Fusion with Potash,*" by H. Hlasiwetz and L. Barth.

"*On the Artificial Formation of Resins,*" by the same authors.

"*On Eugenic Acid,*" by H. Hlasiwetz and A. Grabowski.

"*On Umbelliferone,*" by the same authors.

No. 2. August.

"*On Malonic Acid,*" by C. Heintzel.

"*Researches on the Oxacids of the Aromatic Series,*" by C. Graebe.

"*On the Behaviour of Anisol towards Hydriodic Acid,*" by the same author.

"*On the Action of Sulphurous Acid on Hydrated Oxide of Platinum,*" by C. Birnbaum.

"*On Ditolyl, a New Compound Isomeric with Dibenzyl,*" by R. Fittig.

"*On Methyl-xylol and Ethyl-xylol,*" by T. Ernst and R. Fittig.

"*On some New Derivatives of Valerianic Acid,*" by J. Clark and R. Fittig.

"*On the Action of Hydriodic Acid on Glycerine,*" by E. Erlenmeyer.

"*On the Action of Bromacetic Acid on Aniline,*" by C. Michaelson and E. Lippmann.

"*On the Composition of Wiserine,*" by V. Wartha.

"*On a New Series of Hydrocarbons,*" by C. Schorlemmer.

"*On Borocalcite,*" by K. Kraut.

No. 3. September.

"*Researches on Isomalic Acid,*" by H. Kammerer.

"*On some Decompositions of Chloride of Ethyl,*" by L. Meyer.

"*On some Chlorinated Substitution Products of Toluol,*" by H. Limpricht.

"*On Isomerism in the Benzoic Series: On the Behaviour of the Homologues of Benzene towards Chlorine,*" by F. Beilstein and P. Geitner.

"*On the Compounds produced by the Action of Absolute Alcohol on Terchloride of Phosphorus,*" by M. Meuschutkin.

"*On a New Series of Organic Sulphur Compounds,*" by A. Saytzeff.

"*On Ethyl-Sulphurous Acid,*" by G. Wischin.

Why?—We cut the following from yesterday's *Times*:—"We have been given to understand that her Majesty has been pleased, on the recommendation of Lord Derby, to grant to Dr. Arthur Hill Hassall, the eminent physician and analyst, a pension from the Civil List, in recognition of his public services,"

NOTICES OF PATENTS.

No. 484. *Compound for preventing and removing Incrustation in Steam Boilers, &c.* Peter Ward, Bristol. Dated February 15, 1866.

This invention has for its object improvements in preparing materials for preventing and removing incrustation in steam boilers, for lubricating machinery, and for scouring cloth and other substances. In preparing the compound for the prevention and the removing of incrustations in steam boilers, the patentee uses 5 cwt. of commercial caustic soda, 10 cwt. of dry peat in a pulverised state, and about 10 cwt. to 15 cwt. of water. The whole is put into a cast-iron pan and boiled until all the peat has become dissolved, and the evaporation may be continued until the mass has become so far concentrated that when cold it will be about the same consistency as soft soap. When caustic potash is used, the proportions should be regulated according to the strength or quality of the alkali employed, 9 cwt. of commercial potash (containing 48 per cent. of potash) being about equivalent to the 5 cwt. of soda in the soda compound. In preparing water for use in steam boilers, he adds from ½ to 1½ lbs. of either of the above compounds to each 100 gallons of water (an excess of compound will do no harm), according as the water contains more or less earthy matter in solution. In preparing lubricating grease from the above compound, he mixes therewith enough of petroleum or other cheap oil or fatty matter to give the compound a good lubricating quality. 12 cwt. of the peat compound and 8 cwt. of petroleum oil make a very suitable grease for any ordinary purpose. The oil or other fatty matter should be mixed with the peat compound whilst hot, and agitated from time to time until cold, when it will be ready for use for lubricating in lieu of oil or grease. In preparing the compound for scouring purposes, soft or hard soap may be combined therewith whilst in the process of preparing.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W. C.

2360. A. Cairns, Liverpool, "Improvements in the construction of liquid compasses."—Petition recorded Sept. 14, 1866.

2400. A. R. Stark, Woolwich, Kent, "Improvements in the manufacture of gas."—Sept. 18, 1866.

2470. G. E. Van Derburgh, New York, U.S.A., "Improvements in the composition and production of artificial stone cements and other compositions."—Sept. 25, 1866.

2593. G. T. Bousfield, Loughborough Park, Brixton, Surrey, "Improvements in separating sulphur from soda waste."—A communication from P. W. Hofmann, Ph D., Dieuze, France.—Oct. 6, 1866.

2607. T. Outram, Grutland, near Halifax, "Improvements in the manufacture of cast iron."—Oct. 9, 1866.

2623.—A. H. Brandon, Rue Gaillon, Paris, "Certain new and useful improvements in electrical apparatus."—A communication from G. L. Leclanché, Paris.—Oct. 10, 1866.

Notices to Proceed.

1633. W. B. Brown, Manchester, "An improved anti-acid oil."—Petition recorded June 16, 1866.

1640. W. B. Patrick, Mincing Lane, London, "Improvements in the treatment of animal charcoal used by sugar refiners or others in order to its re-use."—June 18, 1866.

1642. A. Paraf, Manchester, "Improvements in fixing colouring matters on textile fabrics, yarns, or other materials."—June 19, 1866.

1657. J. Möller, Shaftesbury Villas, Hornsey Rise, Islington, Middlesex, "Improvements in obtaining and preparing colouring matter for printing, dyeing, and other purposes"—June 20, 1866.

CORRESPONDENCE.

Manufacture of Tetrachloride of Carbon.

To the Editor of the Chemical News.

Sir,—Before reading Dr. Müller's letter in the Chemical News of October 9, I had no knowledge whatever of the results which had been obtained by him. Having read the paper to which he refers, I fully admit the justice of his claim.

I do not understand him to state in his letter that he was aware that tetrachloride of carbon could be produced as an article of commerce by the reaction in question.

I am, &c. C. Crump.

Southcombe, Paignton, October 28.

Process for the Estimation of Resin in Soaps.

To the Editor of the Chemical News.

Sir,—In an article under the above heading, by Mr. G. Sutherland, which appeared in the last number of the Chemical News, the author, after first decomposing the soap with hydrochloric acid, treats the mixture of the resinous and fatty acids with nitric acid at a boiling temperature, his object being to convert the resinous acids into the soluble terebic acid, and to leave the weight of the fatty acid present unaltered; but I am afraid our friend has overlooked the facts that stearic acid is converted immediately into margaric acid, and that margaric and oleic acids, by boiling with nitric acid, furnish the homologous members of the acetic series, down to rutic acid,

$$\left.\begin{matrix} C_{10}H_{19}O \\ H \end{matrix}\right\} O,$$

and also five members of the succinic acid series. So that, instead of giving the weight of the fatty acid in the soap, this process gives the weight of the acids of the acetic series which have not been washed away or volatilised at the low temperature mentioned. The members of the succinic acid series will have been removed by the washing, so that the results obtained are in truth of no value.

I am, &c. S. H. J.

Wolverhampton, October 23.

MISCELLANEOUS.

Two Cases of Poisoning by the External Use of Belladonna.—The volume of "London Hospital Reports" just issued contains accounts of two cases in which severe symptoms of poisoning were produced by the external application of belladonna preparations. They are so interesting, and a wide knowledge of them may be so useful, that we quote them at some length. The first was the case of a nobleman for whom a liniment containing two drachms of liquor belladonnæ in two ounces of soap liniment had been ordered. After using it he hastily summoned his physician, who found him with all the usual symptoms of poisoning by belladonna —widely-dilated pupils, considerable cerebral excitement, and rapid pulse. Another liniment without the belladonna was prescribed, and the doctor left. The next day he was again hastily summoned, and found his patient with a solicitor, three keepers, and a "mad doctor," who had already signed a certificate of insanity. It turned out that the liniment containing belladonna had by mistake been applied a second time, and hence a return of the cerebral excitement rather exaggerated. We need not describe the delusions of the patient. Dr. Brown soon explained to the "learned psychologist" and the solicitor that the patient's state was attributable to the belladonna, and that the symptoms would quickly disappear, as indeed they did. "The case," remarks Dr. Brown, "is instructive, first of all as illustrating the small quantity of this drug from either the external or internal use of which symptoms of poisoning may arise; in the next, to act as a danger signal, to warn us from incarcerating, upon a single interview, a patient of whose history and previous treatment we know nothing." The next is a case (related by Dr. Fraser) of a servant girl who was taken to the London Hospital by her mistress, who was afraid the girl was "going out of her mind." She was extremely restless, would wander about the room, stand first on one foot and then on the other, but was quiet for a moment when spoken to, and answered a question with an effort, generally breaking off in the middle as if she had forgotten what she had to say. It was noticed at once that her pupils were widely dilated and fixed. It was subsequently discovered that she had had pain in her breasts for some days, and had gone to a chemist who had given her a lotion composed of extract. belladonnæ 3ss., aquæ 3j., with directions to apply it on cotton wool covered with oiled silk. She applied some in the evening and again in the morning, and in the afternoon the symptoms appeared which induced her mistress to take her to the hospital. The girl expressly denied having swallowed any of the lotion. She did not recover so quickly as the before-mentioned patient, but was quite well in six days.

The Metropolitan Waters for October, 1866, by Professor Frankland, F.R.S.—The marked improvement in the amount of organic matter in the river waters supplied to the metropolis which was observed last month has not been maintained in the case of the waters supplied by the Southwark, the Lambeth, and the East London Companies. The table exhibits the effect of filtering the East London Company's water through animal charcoal. A comparison of the results yielded by this water before and after filtration shows this marvellous effect of animal charcoal in removing, not only organic, but also mineral impurities, from water filtered through it. Thus, the organic and other volatile matter contained in the East London Company's water is reduced to less than one-fourth by this operation, and the residual quantity contains but mere traces of organic matter, since the filtered water on evaporation leaves a snow-white residue, which is scarcely perceptibly altered in colour on ignition; the hardness is also reduced from 20·2 to 7·1. In fact, the waters of the New River and East London Companies, although so different in purity as delivered to consumers, become almost identical after filtration through animal charcoal. This filtration was not performed on the small scale for the purposes of the analysis, the sample examined having been taken from the daily supply of about 700 inhabitants in Columbia Square, Shoreditch.

ANSWERS TO CORRESPONDENTS.

C. R.—The delay has been unavoidable.

W. B. G.—The demand for our earlier numbers, though large, is not nearly sufficient to warrant the reprinting of Vols. I. and II.

Carbo.—Sulphate of magnesia is not considered so good a test for phosphoric acid as molybdate of ammonia.

A Constant Reader must also be a careless one, as the article asked for was given in our pages three weeks ago.

Doubtful.—You can easily see if the pink colour of the manganese salt is due to the presence of cobalt or of a higher oxide of manganese by adding sulphurous acid. If due to cobalt, the colour will remain, whilst if due to a higher oxide of manganese the solution will be bleached.

Magnesium.—We do not think the bars are yet to be obtained in commerce.

A. B. S.—Acetylene was first discovered by M. Ed. Davy, but its synthetical formation is due to M. Berthelot, who has worked a good deal upon it.

A Gas Engineer.—The detection of bisulphide of carbon in coal gas is a difficult problem. Several plans have been recommended, but they all require some knowledge of chemistry to enable them to be fairly tried. Dr. Hofmann's process with triethylphosphine is the most sensitive known, but the base is tedious and difficult to prepare. We have heard that very good results have been obtained by using Dr. Herzog's process, given at page 330 of our third volume.

Received.—W. L. Scott.

Books Received.—The Student's Text-book of Electricity, by Henry M. Noad, Ph.D., F.R.S., &c.; On the Eozoonal Rock, by Professors W. King and T. H. Rowney; Thorley's Farmer's Almanack, 1867; Little Experiments for Little Chemists, by W. H. Walenn, F.C.S.

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By WILLIAM ALLEN MILLER, Esq., M.D., F.R.S.,

Treasurer of the Royal Society, Professor of Chemistry at King's College, and Assayist to the Royal Mint

(Copy.)

King's College, London, 17th October, 1866.

SIRS,—

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In compliance with your request, I have analysed a sample of Cod-liver Oil, labelled as follows:—

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Specific gravity .. .. 0·925.

It may be cooled down below 50° F. without becoming opalescent; but at a few degrees above the freezing-point of water it becomes thickened and loses its transparency, which it completely recovers again as the temperature rises.

As will be seen from the subjoined Analysis, it contains scarcely anything soluble in water or alcohol, and very little biliary matter.

The details of the analysis are as follows:—

Olein, with a little stearin in solution	99·490
Biliary matter, soluble in water	0·052
Matter, soluble in alcohol	0·458
Iodine	Traces
	100·000

I am, Sirs, yours truly,

To Messrs. Bedford Brothers. (Signed) WM. ALLEN MILLER.

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HODGKINSON, TONGE, and STEAD, Upper Thames St., E.C.
DANIEL JUDSON and SONS, Drysalters, Coleman St., E.C.
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THE

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AND

Journal of Physical Science.

Edited by] [*Wm. Crookes, F.R.S.*

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Removal of Nitric Acid from Sulphuric Acid by Charcoal, by William Skey, *Analyst to the Geological Survey, New Zealand.*

In certain analytical operations, also for voltaic batteries, it is sometimes necessary to use sulphuric acid which is uncontaminated with nitric acid; but their separation has hitherto been a matter of difficulty, only attained by methods of a very protracted nature.

In the case of dilute sulphuric acid, however, this can be effected by shaking it up with a little freshly burned charcoal in a state of powder for a few minutes and afterwards filtering.

Sulphuric acid which has passed through this operation does not give any reaction of nitric acid when left in contact with crystallised sulphate of iron, although before the action may have been very decided.

But if concentrated sulphuric acid, which is only very slightly admixed with nitric acid, be taken and agitated with charcoal as before, it will be found, even after a very long contact, that a crystal of sulphate of iron immersed in it is turned of a pink colour just as quickly as if charcoal had not been used.

This refusal of charcoal to absorb nitric acid from its solution in concentrated sulphuric acid, would seem to indicate that this acid is retained by the charcoal in the first instance in the form of a hydrate, the dilute condition of the sulphuric acid employed preventing its decomposition.

On the Isomorphism of Thallium-Perchlorate with the Potassium and Ammonium-Perchlorates, by Prof. H. E. Roscoe, *F.R.S., &c.*

The recently ascertained isomorphism of the thallium- and ammonium-sulphates* renders it highly probable that the perchlorates of these metals also exhibit isomorphous relations.

Thallium-perchlorate equals the alkaline-perchlorates in stability. It can be readily prepared either by dissolving metallic thallium in aqueous perchloric acid, or by the double decomposition of thallium-sulphate and barium-perchlorate. From solution the anhydrous salt is easily deposited in colourless rhombic crystals, which are transparent, bright, well-defined, and non-deliquescent. The specific gravity of the crystals is 4·844 at 15·59 C.; they dissolve in ten times their weight of water at 15°, and in about $\frac{3}{5}$ths of their weight of water at 100°; the salt is also slightly soluble in alcohol. Thallium-perchlorate does not lose weight when heated to 200° C., and the temperature may even be raised to within a few degrees of the boiling-point of mercury without producing the slightest decomposition of the salt. On the further application of heat, a black mass is formed, and the salt finally volatilises as thallium-chloride.

The crystalline form of thallium-perchlorate is that of a right rhombic prism, in which the faces of the rhombic octahedron and the basal faces of the prism generally appear; the crystals being lengthened, as is the case with the alkaline-perchlorates, sometimes in the direction of the prismatic, and sometimes in the direction of the octahedral faces.

The angles observed by Mitscherlich† in the case of potassium- and ammonium-perchlorates agree exactly with the above. The following analysis, made in my laboratory by Mr. T. E. Thorpe, shows that the formula of the salt is $TlClO_4$.

I. Determination of Thallium. — The crystals were well dried in vacuo over sulphuric acid, and precipitated with platinum-tetrachloride, the passage of the finely divided precipitate through the filter being avoided by evaporating to dryness on the water-bath, and taking up with absolute alcohol.

(a) Salt prepared by direct solution of the metal in perchloric acid: 0·1831 salt yielded 0·2476 chloroplatinate.

(b) Salt prepared by double decomposition: 0·4502 salt yielded 0·6060 chloroplatinate.

II. Determination of Perchloric Acid. — A solution of potassium-acetate was added to the thallium-perchlorate, and the whole evaporated to dryness on a water-bath, the acetates of thallium and potassium washed out with absolute alcohol, and the insoluble potassium-perchlorate collected on a weighed filter; 0·4570 thallium-perchlorate yielded 0·2100 potassium-perchlorate. Hence:—

	Calculated.		Found. I.	Found. II.	Found. III.
Tl .	204·0	67·21	67·38(a)	67·18(b)	
Cl .	35·5	21·09			32·96
O_4 .	64·0	11·70			
	303·5	100·00			

An Introduction to Chemical Philosophy, according to the Modern Theories, by Adolphe Wurtz, *F.R.S.*

Part III.

Connexion between Organic and Inorganic Chemistry.

Section V.—*Inorganic and Organic Nitrides.*

(*Continued from page* 194.)

Reiset's salt, which is formed when Magnus's salt or chloride of platosonium is digested with an excess of ammonia, may be regarded as the dichloride of diamiplatosonium—

$$\left.\begin{matrix} Bt'' \\ Am_2 \\ H_2 \\ H_2 \end{matrix}\right\} N_2.Cl_2.*$$

These examples, which might be greatly multiplied, will suffice to show that the capacity of saturation of the ammoniaco-metallic bases is not always in proportion to the quantity of nitrogen which they contain. Thus, the ammonium of Reiset's salt contains 4 atoms of nitrogen, two of which are in Am_2, and unites only with 2 atoms of chlorine.

We know, by the valuable researches of Dr. Hofmann, that it is the same with the polyamines or organic polyammonias. Thus the ethylenic triammonias or ethylenic triamines† can form three kinds of salts, which are as follows, for the diethylenic triamine, which we will take as an example—

$$\left.\begin{matrix} (C_2H_4)_2 \\ H_3 \end{matrix}\right\} N_3,3HCl.$$

$$\left.\begin{matrix} (C_2H_4)_2 \\ H_3 \end{matrix}\right\} N_3,2HCl.$$

$$\left.\begin{matrix} (C_2H_4)_2 \\ H_3 \end{matrix}\right\} N_3,HCl.$$

---

* Lang, *Phil. Mag.*, xxv., 248.
† Pogg. *Ann.*, xxv. (1832), p. 301.

* Hofmann.
† Hofmann, *Comptes Rendus*, vol. lii., p. 947.

The second of these salts is a diacid triamine, the third a monacid triamine. In accordance with the system of notation adopted above, the diacid salt may be formularised in the following manner:—

$$\left.\begin{matrix}(C_2H_4)_2\\ NH_4\\ H_3\end{matrix}\right\}N_2.Cl_2 \quad \text{or} \quad \left.\begin{matrix}(C_2H_4)_2\\ Am\\ H_3\end{matrix}\right\}N_2.Cl_2$$

Inversely, nothing prevents us from considering the cuprous, cobaltous, and platinous ammoniacal combinations in question as diacid tetramines—that is to say, incompletely saturated:—

$$\left.\begin{matrix}[Cu_2]''\\ H_{10}\end{matrix}\right\}N_4,H_2I_2, \qquad \left.\begin{matrix}Co''\\ H_{10}\end{matrix}\right\}N_4,H_2Cl_2, \qquad \left.\begin{matrix}Pt''\\ H_{10}\end{matrix}\right\}N_4,H_2Cl_2$$

Ammoniacal cuprous iodide. Ammoniacal chloride of cobalt. Reiset's salt.

I do not put forward these formulæ as being preferable to those before given; my aim is merely to show that we know, in inorganic and organic chemistry, of combinations formed by the fixation of ammonia upon a chloride, a bromide, &c., and whose capacity of saturation is not in proportion to the quantities of ammonia retained.

But there are other analogies which we meet with without going out of the group of compounds that we have been considering. Dr. Hofmann has proved that trimethylamine, Me_3N, may unite with dibromide of ethylene, $C_2H_4Br_2$, to form a bromide

$$\left.\begin{matrix}(C_2H_4Br)'\\ Me_3\end{matrix}\right\}N.Br.$$

In this body we see the group

$$C_2H_4Br = C_2H_4Br_2 - Br$$

takes the place of 1 atom of hydrogen in a compound ammonium. Similarly the group

$$[PtCl_2]'' = Pt^{iv}Cl_4 - Cl_2$$

may replace 2 atoms of hydrogen.

When a current of chlorine is directed upon the green Magnus's salt (chloride of platosonium), it is changed by absorbing 2 atoms of chlorine into chloride of chloroplatammonium (Gerhardt).

$$\left.\begin{matrix}[Pt_2Cl_2]''\\ H_2\\ H_2\\ H_2\end{matrix}\right\}N_2.Cl_2$$

There also exists a chloride of diamichloroplatammonium—

$$\left.\begin{matrix}(PtCl_2)''\\ Am_2\\ H_2\\ H_2\end{matrix}\right\}N_2.Cl_2$$

It is formed by the union of chlorine with chloride of diamiplatosonium or Reiset salt.

All the formulæ we have given above in which diatomic metals enter are double those which M. H. Schiff has adopted in his remarkable work. It appears to us, in fact, that these metals may unite several molecules of ammonia, as ethylene does in the ethylenic ammonias.

(To be continued.)

New Researches on the Law of Chemical Proportions, and on Atomic Weights and their Mutual Relations, by J. S. Stas.*

(Continued from page 206.)

In order to render the proofs as rigid as can be, I have thought it indispensable radically to change the system of synthesis and analysis used by all chemists. Till now, syntheses, like analyses, have been made by *difference*. This method, in synthesis, presupposes that the weight of the element employed is found integrally in the resulting compound, and, moreover, that the compound produced and weighed, contains absolutely only the simple or complex body which was at first combined. In this system, the operation of analysis or synthesis does not contain in itself the means of rightly determining the error which it involves. It only permits an idea of the accuracy of the result to be formed, by the frequent repetition of the same operation; therefore, this being the case, it is *impossible to allow for the constant error*. The method by difference, alike presents the inconvenience of not furnishing, by the operation itself, an idea of the purity of the material or materials used in the experiment. For all these reasons, I have thought, that in syntheses and analyses which have for their object the determination of atomic weights, it is necessary to employ a method in which the weight of the combined elements, as well as that of the separated elements, is fixed by the experiment itself. Thus, for a synthesis of two bodies A and B, the weight of A, the weight of B, and after their union the weight of the product A B, must be determined; and in the same manner, in the analysis of a compound A B C, when it is wished to ascertain the relation of A B to C, the weight of A B C, the weight of A B, and the weight of C which is derived from it, should be determined separately. It is only in proportion as these conditions are realised, that the limit of error which all operations involve, can be exactly measured.

I have applied this system rigorously to the synthesis of iodide and bromide of silver, and to the analysis of the iodate of this metal; for the reasons which I point out in my work, I have failed in the complete application of it which I tried to make in the analysis of bromate and chlorate of silver. It may besides be imagined that it is only very exceptionally that these principles will be able to be realised in all their rigour in the synthesis and analysis of bodies. The results at which I have arrived are recorded in my second memoir entitled "*New Researches on the Atomic Weights of Silver, Iodine, Bromine, and Chlorine, made for the purpose of proving whether the atomic weight of silver, determined by the aid of these three bodies, is the same, and whether these atomic weights are agreeable to Prout's hypothesis.*" This memoir consists of the nine following notices:—

1st. *On the systems employed in making syntheses and analyses.*

2nd. *Syntheses by difference of iodide of silver.*

3rd. *Abridged and complete syntheses of iodide of silver.*

4th. *Syntheses by difference of bromide of silver.*

5th. *Abridged and complete syntheses of bromide of silver.*

6th. *Complete analyses of iodate of silver.*

7th. *Analyses by difference of iodate of silver.*

8th. *Analyses by difference of bromate of silver.*

9th. *Analyses by difference of chlorate of silver.*

The results which proceed from these long and difficult labours are, that the composition of iodide, bromide, and chlorate of silver, determined, twenty years ago, by M. Marignac, is strictly correct; that the composition of iodide of silver is absolutely irreconcilable with Prout's hypothesis; that neither does the composition of the iodate, bromate, and chlorate agree with this hypothesis; that the atomic weight of silver, deduced from these *three independent data*, is almost absolutely the same, and is identical with the atomic weight

* *Memoirs of the Royal Academy of Belgium.*

deduced from the synthesis of the chloride and the analysis of the chlorate made by M. Marignac, and from the synthesis of the sulphide and the analysis of the sulphate effected by me.

In fact, the mean atomic weight of silver is :—

1st.	*According to the syntheses of the chloride and the analyses of the chlorate made by M. Marignac*	107·915
2nd.	*By my syntheses of the sulphide and analyses of sulphate*	107·920
3rd.	*By my syntheses of the iodide and analyses of iodate*	107·928
4th.	*By my syntheses of bromide and analyses of bromate*	107·921
5th.	*By my syntheses of chloride and analyses of chlorate*	107·937

If the doubt raised by M. Marignac on the subject of my syntheses of sulphide and nitrate of silver had received no satisfactory solution by the direct proofs to which I have submitted the law of chemical proportions, the agreement presented by the atomic weight of silver determined by means of *four absolutely independent data* would be sufficient, it seems to me, to dispel it for ever.

In a word, I desired greatly to submit the other results contained in my "*Researches on the Reciprocal Relations of Atomic Weights*" to a fresh verification, by making use of new and independent methods, especially after having been accused of turning my back on truth and progress.†

Among the bodies which have been the object of my investigations, nitrogen is the one whose atomic weight departs most from Prout's law — considering, of course, its relatively slight weight. According to this hypothesis, its atomic weight is represented by 14·00. But I found that it is equal to 14·06 by deducing it from chloride of ammonium, supposing, of course, by an entirely gratuitous hypothesis, that the relation of hydrogen to oxygen is as 1 : 16·00; and I found that it is, at the maximum, 14·046, and at the mean, 14·041, by deducing it from the synthesis of nitrate of silver. I should like to have submitted these results to a direct control by the analysis of nitrous oxide, effected according to the system explained above—that is to say, by weighing the compound and each of its isolated elements. Unfortunately, I have hitherto found no mechanician who has dared to undertake the construction of the apparatus, in the conditions which I think indispensable for the success of the experiment.

This plan failing me, I have had recourse to an *indirect* way which furnishes extraordinarily concordant and certain results, when the trouble is taken of applying it to compounds into which variable elements enter by the side of the constant elements. I thought to find this means in the *transformation of chlorides into nitrates*. This method has, moreover, been practised by Dr. Penny of Glasgow. The chlorides on which I have operated are those of potassium, sodium, and lithium. I have also made new syntheses of nitrate of silver, in order to be able to control my old experiments, and deduce with certainty the atomic weight of nitrogen from the relative weights of chloride and nitrate produced by a unit weight of silver. By the help of new researches, I have proved the atomic weight of lithium, which was determined three years ago, by M. Carl Diehl, and confirmed more recently by the labours of M. Troost.

It is indeed imagined that it must be possible by the transformation of a chloride into nitrate, or by the determination of the proportionate weights of chloride and nitrate obtained by the aid of a unit weight of metal, to prove the accuracy of any given atomic weight, if that of the elements composing the chloride is sufficiently determined.

According to the law of chemical proportions and the composition of nitrates, the difference between the weight of a molecule of a chloride and that of a molecule of the corresponding nitrate ought to be equal to a *constant*, represented by the difference existing between the atomic weight of chlorine and the sum of the weights of one atom of nitrogen and three atoms of oxygen. According to Prout's hypothesis, by taking chlorine = 35·50, nitrogen = 14·00, and oxygen = 16·00, the constant ought to be equal to 26·50.

(To be continued.)

† *Cosmos*, 1860, xvii. 656.

REPORT ON THE

CHEMICAL LABORATORIES

IN COURSE OF ERECTION IN THE

UNIVERSITIES OF BONN AND BERLIN.

The Chemical Laboratories of the Rhenish Frederick William University of Bonn.

(*Continued from page* 214.)

To become acquainted with the remainder of the rooms intended to supply the special wants of the three laboratories, we must retrace our steps to the main corridor (*a*, *a*, *a*)* between the principal entrance and the director's study, from which at *a'*, *a'*, *a'*, we had entered the three laboratories. Along this corridor lies a series of rooms opening upon it, and lighted by windows overlooking the back courts of the institution. Close to the vestibule, immediately to the right and lying between the entrance to the first and second laboratories, is, first of all, the Volumetrical Analysis Room (L), the very name of which implies the purpose for which it is intended. This room, in which are kept the standard solutions, daily increasing in variety, as well as the graduated vessels, burettes, &c., required in volumetric analysis, is open to all the students of the institution, but is more especially used by those of the second and third laboratories.

The Balance Room (M), the next in order, is not only intended for the reception of chemical balances, but also of the more delicate physical instruments made use of in analysis, such as air-pumps, barometers, &c.

Next follows a Room for Fusions and Ignitions (N) capable of being carried out by means of gas. Here are the necessary appliances for the various heating operations occurring in mineral analysis. This room is also fitted up with all the requirements for organic analysis (carbon and nitrogen determination), likewise exclusively conducted by means of gas, and carried on in special "combustion niches" let into the walls, and communicating directly with the outer air by means of wide tubes of glazed earthenware. Lastly, this room contains the ranges of water ovens required for drying the substances to be submitted to analysis. In these ovens, which are heated by the steam of the stills for distilled water in the basement, every student has his own compartment under lock and key. With respect to the uses of these three rooms, they are more especially intended for the workers in the middle laboratory; they are, however, accessible also to the beginners, a greater or less number of whom, advancing more rapidly than their fellow-students, will thus be enabled to participate in the facilities supplied by these apartments. The balance room is purposely situated in the middle, and separated from the laboratories by the volumetric analysis room on the one side, and the room for fusions and ignitions on the other, so as to protect, as

* For diagram see last number (Fig. 2), p. 211.

effectually as possible, the costly instruments of this room from the fumes, which, in spite of all ventilation, at times escape in a laboratory. The situation of the balance room, between the two others, affords an additional and a by no means trifling advantage. Numerous operations preceding the weighings, such as drying substances in the water bath, heating crucibles, collecting the combustion products in organic analysis, &c., all take place in the immediate neighbourhood of the balance, whilst on the other hand the preliminary weighings, which invariably form the first step in volumetric analysis, can be made in close proximity to the room devoted to the subsequent stages of volumetric observation. The three rooms, therefore, communicate directly with each other.

Between the second laboratory and the third laboratory are, in addition to a small flight of steps leading to a number of attics over the ground floor, three similar rooms (O, P, and Q), accessible from the corridor, and with doors opening into each other. Of these, the one nearest the second laboratory is intended for the Library (O).

The principal results of chemical investigation are duly registered in treatises and manuals, and are therefore easily within the reach of students. But the statements to be found in books of this description cannot be more than abstracts, always very considerably condensed, and often more or less garbled, from the memoirs of the first observers. As soon, therefore, as the student has got beyond the first rudiments, he can no longer dispense with original sources of information. The main bulk of chemical observation is collected in a series of periodicals and journals, the volumes of which are counted by hundreds, and, if all were collected, certainly by thousands. Again, many important investigations have been communicated by their authors to the various academies and learned corporations, and are printed in the transactions of these societies. Thus it happens that the literature of chemistry, though the youngest of sciences, has already attained to very considerable dimensions, and to collect the works which have to be consulted in the prosecution of even limited investigations in most cases far exceeds the power of any single individual. These books could, of course, be readily procured from any public library, but reference to original communications is but too frequently omitted if the work is only to be had by specially sending for it. On this account every chemical school should possess a library, more or less complete, offering to the student a copious collection of original memoirs which he can consult whenever he may require their assistance. The usefulness, it may be said the necessity, of such libraries is so apparent that the students themselves have in a great many instances most materially participated in their foundation and subsequent increase. In this way, from but small beginnings, some most complete collections of chemical works have been formed. The Reporter, when a young student, had the good fortune to take part in the establishment of such a laboratory collection, under the auspices of his illustrious master, Baron Liebig, at Giessen, which is now the oldest and probably the largest chemical library extant. In later times he had the pleasure of assisting in the inauguration of a similar collection for the Royal College of Chemistry in London. Such a library it is of course in contemplation to establish for the Bonn laboratory, and already, long before its opening, a number of books have come in as presents, which are here gratefully acknowledged as examples for imitation. The situation of the room set apart for their reception, between the second and third laboratories, is peculiarly appropriate, because it is more especially to the students of these two laboratories that the library will be of use, whilst its slight distance from that part of the institution where the director carries on his own researches, is likewise a great convenience to him and his assistants.

The two remaining rooms lying between the second and third laboratories are a Balance Room (P) and a Room for Fusions and Ignitions (Q). They hold the same relation to the third laboratory which obtains between the corresponding apartments (M and N) and the middle laboratory, so that, as regards the special appliances provided and the particular position assigned to them, what has been said of the last-mentioned rooms holds good for them also.

With these rooms on the right-hand side of the principal corridor, terminate the ground-floor apartments intended for practical instruction. We have now only to glance at the theatre and adjoining rooms for preparing the lectures and preserving apparatus, models, drawings, and collections of all kinds.

The students attending chemical lectures in the German Universities are always much more numerous than those who work in the laboratories, and, therefore, much more accommodation had to be provided in the lecture hall † than in the laboratories. A lecture room capable of holding two hundred and fifty students appeared likely to meet the requirements of the University of Bonn. An area of forty feet square was found to be sufficient for this purpose, and at the same time to afford ample space for a convenient lecture-table, as well as for the free and easy movement of the lecturer and his assistants.

The approach to the lecture room is likewise in the principal corridor. Just half-way along the latter, opposite the entrance to the middle laboratory, is a Staircase Hall (*a*″), twenty-six feet in height, and provided with a skylight. This hall is entered from the corridor through an archway resting on columns, and leading by a broad flight of stairs to a Landing (*g*) eight feet above the ground floor, overlying the thoroughfare between the front courts. Passing the folding doors before us, we enter the Great Lecture Hall (R) on a level with its upper row of seats which are arranged like the tiers of an amphitheatre, and reach the lower area of the room by the steps near the wall on either side. In this lower part just opposite the entrance is placed the lecture-table, forty feet long and three feet four inches wide. In the lower part of the wall, behind the table, are the evaporation and ventilation niches for experiments, whilst on its upper part drawings and diagrams can be exhibited. Here, as on former occasions, the Reporter must forego giving details of the numerous appliances designed for the lecturer, which are still far from being complete; suffice it to mention that the lecture room is lighted from both sides, so that neither professor nor audience is obliged to face the light—an advantage sure to be appreciated by any one who has been either lecturer or hearer in a room of different construction. The fourteen windows which supply the light are arranged at a height of nine feet above the floor of the hall, except the two next the lecturer, which descend to the level of the table, enabling him to exhibit many colour-phenomena by means of transmitted light, and to employ sunlight, under favourable conditions, as an agent in his experimental illustrations.

The theatre communicates with the Laboratory of the Lecture-Assistant (S) by means of two side doors, and a large niche in the centre of the wall. Here everything required for the lecturer is got in readiness, and all the necessary furnaces and benches are provided. In this room larger pieces of apparatus can be fitted up upon a table moving on rails, which may be run through the niche already mentioned into the theatre during the course of the lecture. This laboratory is lighted from two sides, on the north-east by a large window, and on the south-west by a glass door communicating with a Platform (*h*); whence a staircase leads down to the Front Court (*i*). These steps also communicate with the rooms of the basement underneath, for the storage of compounds requiring a low temperature, sealed tubes containing condensed gases, &c., and likewise give access to a well-ventilated

† During the winter session of 1865-6 the University of Bonn was attended by 318 matriculated and 35 non-matriculated students; total number of students, 853.

closet immediately under the lecture-table, containing the large galvanic battery, the wires of which pass through the ceiling into the theatre above. The room, where the experiments for the lectures are prepared, is of course in close connexion with the Store-room for Apparatus, Models, Drawings, Diagrams, &c. (T); this room likewise is lighted from both sides. Farther on we come to the last room of this series, having but one window, which is used for the preservation of the various documents belonging to the lectures, such as printed forms, registered lists of students attending, &c., and where the professor may stay before entering the theatre, and after the lecture receive those students who wish to consult him. This room, called the Lecturers' Waiting Room (U), communicates with the Mineralogical Museum (V), one of the great halls assigned to the scientific collections of the Institution. This hall, as well as the one next to it, which, being profusely lighted by six windows symmetrically disposed on both sides, is intended for the Chemical Museum (W), is in the front block of the building. Close to the mineralogical museum is a small Lecture Room (X) for recapitulations and special lectures to be conducted by the assistants. It is separated from the mineralogical museum by a small room with one window to be used either as a Waiting Room (Y) for the Assistant, or as a preparation room for private courses or special lectures. Students working in the laboratories reach this small lecture room by descending the steps leading from the staircase hall into the thoroughfare between the front courts, crossing the left front court, and ascending, lastly, the Flight of Steps (ζ) to the corridor of the ground-floor on which the small lecture room is situated; whilst those who are not laboratory students have access to it by the left main entrance in the front block of the building.

A glance at the ground-plan shows that all the rooms for apparatus, chemical preparations, &c., used in the lectures are situated between the two rooms (R and X) devoted to oral demonstrations, so that all requisites for the lectures can be conveyed with the greatest ease either to the larger or the smaller theatre, and back to the collections. The museums were purposely somewhat removed from the busier departments of the institution. The experience of the Reporter, which is not unlikely to receive confirmation from others, has taught him that the love of research and zeal for discovery in young chemists, however praiseworthy in themselves, are at times anything but conducive to the increase of scientific collections. But independently of this, it was also desirable to devote this part of the building to museums, and not to laboratories for the use of students, because the floor immediately above is appropriated exclusively to the residence of the director.

The large halls for the mineralogical and chemical collections, together with the smaller theatre and its preparation room, occupy almost the entire ground floor of the front block of the building. In addition to these are still to be mentioned two Vestibules (*m* and *p*), prominently marked in the external architecture of the building, which lead, the one to the Main Staircase (*q*), the other to the Back Staircase (*n*), ascending to the apartments on the first floor; then immediately to the left of the north-east entrance a Lodge (*n*) for the House-porter; and, lastly, close to the south-west entrance, apartments (*o* and *o'*) for one of the Junior Assistants of the institution.

But a few words more, and we have done with the description of the plan of the ground floor. It remains to be explained how the two side wings, uniting the front block with the middle cross-building, have been laid out.

And, first, as regards the side wing stretching out at right angles from the left of the main vestibule in the north-east front: in this wing we have close to the vestibule the Porter's Lodge (*s*), reached by a small Passage (a''''), and communicating with the long Corridor (*t*, *t*), which leads in succession to the Cloak-room (*u*), to two Rooms (*v*, *v*) of the Castellan, and lastly, to two suites of Apartments (*w*, *w*, and *x*, *x*) intended respectively for the First and Second Assistant of the institution. The rooms in this wing are not only accessible from the main vestibule, but likewise by means of a Staircase (*y*) ascending from the front court close to the Carriage Way (*z*).

The other side wing projecting, symmetrically with the one described, from the left of the other end of the main corridor, is entirely devoted to the scientific purposes of the director, with whose study this part of the building is in immediate communication. Among the rooms situated in this wing, mention must first be made of the Private Laboratory of the Director (Z), which is lighted by four windows. On one side of this lies the Director's Waiting Room (α), accessible from the main corridor, and communicating with his study by the short Private Passage (β). Beyond the other end of the private laboratory are two small apartments, one to be used as a Balance Room (γ), the other as a Room (δ) for Ignitions, Fusions, and Combustions. The latter has egress to a little Portico (ϵ), for experiments requiring to be performed in the open air. This portico communicates, moreover, by means of doors, on one side, with the Passage (*k*, *k*, *k*), which runs along all the rooms in this wing, on the other, with a Prolongation of the Passage (k'), whence the director's residence is accessible by means of the Back Staircase (*n*), and the left front court by means of the Flight of Stairs (ζ) already mentioned. The prolongation of the passage likewise establishes communication between the whole side wing and the Main Corridor (*l*) of the front block, thus allowing to the director and his assistants the freest access to the collections, lecture halls with their preparation laboratories, and all the remaining rooms belonging to this department

After this detailed description of the plan of the ground floor, where nearly the whole of the rooms devoted to the special purposes of the institution are situated, a brief comment will suffice to render the remaining drawings intelligible.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, November 1.

Professor W. A. Miller, *M.D., F.R.S., President, in the Chair.*

At this, the first meeting after the long vacation, there was a full attendance of members. The minutes of proceedings at the last (extraordinary) meeting of the Society were read and confirmed, and a long list of donations to the library were announced. Mr. Edward Purser, jun., was formally admitted a Fellow of the Society, and Messrs. W. Chandler Roberts, Associate of the Royal School of Mines, and Edward P. H. Vaughan, patent agent, 54, Chancery Lane, were duly elected. For the second time were read the names of Mr. Robert Biggs, Deputy Coroner, 17, Charles Street, Bath, and Mr. David Page, Galebeck Powder Mills, near Kendal. The following candidates were proposed:—A. C. Cook, Ph.D., Demonstrator of Chemistry, King's College, London; Mr. Henry Dircks, Civil Engineer, Whitehall Club, and 16, Bucklersbury; Mr. James Forrest, Ashburnham Road, Greenwich; Mr. William Huskisson, manufacturing chemist, Gray's Inn Road; Mr. A. F. Marreco, Newcastle College of Medicine; Mr. J. Hancock Richardson, Newcastle-on-Tyne; Alexander Morrison Thomson, D.Sc. Lond., Sydney, New South Wales.

Dr. Hermann Sprengel exhibited and described an apparatus for taking the sample as a preliminary to determining the specific gravity of heterogeneous liquids. The

instrument consists of a cylindrical glass tube about eighteen inches in length, the lower end of which may be temporarily closed by a platinum disc and spring wires, whilst a piston works through an india-rubber cap fitted to the upper extremity. The rod of this piston is composed of a smaller glass tube with a "pinch cock" at the top. To use the instrument for the purpose of taking a sample—say of vitriol from the leaden chambers—the height of the vertical column of liquid is first measured; the piston is then adjusted within the glass tube to a corresponding level, the upper orifice being left open; the whole instrument is then slowly immersed in the acid or other liquid to be tested until the tube has, as it were, cut through a true section of the heterogeneous fluid; the bottom of the tube is closed by exerting slight pressure upon the platinum disc, and the whole withdrawn. The liquid contents of the tube may now be transferred to an ordinary hydrometer glass, thoroughly mixed, and the gravity taken in the usual manner.

Dr. W. De la Rue and Dr. Odling offered some remarks upon the practical use of the instrument, from which the necessity of the vitriol chambers being fixed perfectly level was elicited.

Mr. Ernest T. Chapman then read a paper "*On the Gradual Oxidation of Organic Bodies*," detailing the results of experiments made by Mr. William Thorp and himself upon the action of chromic acid on several organic compounds. Commencing with alcohol and bodies of the vinic series, the authors found that by heating in the water bath with mixtures of sulphuric acid and bichromate of potash contained in sealed tubes, acetic acid was formed without the escape of any carbon in the form of gas. An intermediate stage was remarked, at which acetic ether was the sole product. Amylic alcohol treated in the same way furnished valerianic acid, thus—

$$\text{I. } C_2H_6O + O_2 = C_2H_4O_2 + H_2O.$$
$$\text{II. } C_5H_{12}O + O_2 = C_5H_{10}O_2 + H_2O.$$

The compound ethers were then experimented upon, and the products were similar; thus, the acetate of ethyl was converted entirely into acetic acid, whilst the acetate of amyl furnished a mixture of acetic and valerianic acids. No further action could be observed upon submitting the products to another treatment with the chromic solution, unless at a much higher temperature, when carbonic acid in variable quantity was produced. Nitric ether gave acetic and nitric acids, and with the iodide of ethyl the change was as follows:—

$$2C_2H_5I + O_5 = 2C_2H_4O + H_2O + I_2.$$

The iodide of isopropyl gave acetic and carbonic acids besides free iodine and water. The ammonia-bases similarly treated furnished acids corresponding to the contained radicals, and a salt of ammonia was produced. Of the olefines, ethylene, amylene, and β hexylene were submitted to experiment, when the following reactions were observed:—

$$\text{I. } C_2H_4 + O_6 = 2CO_2 + 2H_2O.$$
$$\text{II. } C_5H_{10} + O_7 = 2C_2H_4O_2 + CO_2 + H_2O.$$
$$\text{III. } C_6H_{12} + O_7 = C_3H_6O_2 + C_2H_4O_2 + CO_2 + H_2O.$$

By the use of stronger solutions of chromic acid, at 130° C., it was noticed that the acid made from valerian root behaved differently from the ordinary valerianic acid made by oxidation; the first-named quality became converted into carbonic and butyric acids; likewise a difference was noticed in the case of fousel oil, which seems to contain two isomeric amylic alcohols, distinguished by the greater facility with which one of them becomes oxidised, and by the greater amount of carbonic acid produced in a given time. Mr. Chapman concluded by referring to a set of graphic diagrams illustrating the hypothetical constitution of the olefines.

Dr. Frankland regretted that he was under the disadvantage of not having heard the first part of the author's communication. As a rule, he preferred the synthetical method of arriving at the constitution of bodies, but the analytical researches just now described appeared worthy of great confidence, and he applauded the careful manner in which the experimenters had pushed the oxidising action, even to the fresh treatment of first products. The employment of Crum Brown's graphic formulæ helped to set the constitution of bodies in a clearer light.

Professor Williamson asked for an explanation of the observed dissociation of carbon in the case of the iodide of iso-propyl being acted upon by chromic acid, and of the manner in which this substance had been prepared.

Mr. Chapman replied that it was obtained direct from glycerin, and if its constitution be correctly represented by the formula $(CH_2)C_2H_5I$, it was clear that the radicals furnished each its respective product, thus—

$$2CH_2(C_2H_5)I + O_{11} = 2C_2H_4O_2 + 2CO_2 + 3H_2O + I_2.$$

The President moved a vote of thanks to the authors, and announced that at the next meeting of the Society a paper "*On Ozone*," by Dr. Daubeny, would be read. The meeting was then adjourned until the 15th inst.

ROYAL SCHOOL OF MINES, MUSEUM OF PRACTICAL GEOLOGY.

A Course of Twelve Lectures on Chemical Geology, by Dr. Percy, F.R.S.

Lecture No. X.

(Continued from page 209.)

In India we find diamond always in the same kind of rock, or a similar kind—namely, in a breccia of red and yellow jasper, quartz, chalcedony, and hornstone, cemented by siliceous matter. This breccia is overlaid by sandstone, and it passes into a conglomerate of rounded pebbles, which are cemented together by a calcareous or calcareo-argillaceous cement. In this conglomerate the diamonds are generally met with. They are found in several parts of India; but I need not trouble you with details. Diamonds are found in Borneo in a conglomerate of pebbles, diorite, and quartz, along with marl containing marine shells; and here we find diamond associated with magnetite—that is, the magnetic oxide of iron, a mineral we shall very shortly describe and examine in detail. Diamond is not only associated here with the magnetic oxide of iron, but (which is deserving of great attention) with gold, platinum, and other things, sometimes very rare minerals. I would particularly direct your attention to the case in the museum upstairs containing illustrations of the mode of occurrence of diamond.

I have said that in Brazil diamonds are met with accompanying this itacolumite rock. This is a most important point, and we must examine it further. Itacolumite rock is commonly termed quartzite. It is a variety of quartz rock. On a large scale it always presents a more or less distinct slaty structure, thereby indicating its sedimentary origin, or the probability of such an origin. I am perfectly aware that slaty structure does not necessarily imply that, but it may be the result of cleavage; but here, at all events, it seems to indicate sedimentary origin. Itacolumite is sometimes traversed by pyrophyllite. It is sometimes found to be flexible. The flexibility of this sandstone may be easily explained, I think, by the interposition or intermixture of little particles of mica. Now, this sandstone is all thrown down, of course, by deposition gradually. If there be mica present, the rate of deposition is various, and you will get little alternate layers of mica and sand, and these matters may overlap one another, and so tend to combine one with the other. This is one way, at all events, in which the flexibility of sandstone may be accounted for.

Itacolumite is believed by geologists to be a metamorphic rock—that is, a rock which has undergone certain changes subsequent to its deposition. The subject of metamorphism is one of very great importance in geology, and one

to which we shall hereafter direct attention. It is stated that no fossils have been found in this rock.

Together with this itacolumite occurs what is called a metamorphic schist—a kind of slate, which is very variable in its character, and contains quartz sometimes associated with chlorite or talc and sometimes with mica. In some cases it is a pure mica schist. It generally forms elevated plains, and it is easily weathered—that is, disintegrated by exposure to the weather. We are told that it frequently passes insensibly into an argillaceous schist, containing talc, and mica, and disthene or cyanite, and also into itacolumite itself; and in one locality fragments of crystalline schist form a conglomerate in the itacolumite itself. Limestone and schistose red iron ore also occur in this metamorphic schist. This variety of red iron ore sometimes forms beds of great extent. This schist is very easily disintegrated, as I said just now, sometimes being weathered and decomposed and softened to a great depth. This softening is the result of the heavy tropical rains which fall there, and which, moreover, are reported to contain nitric acid.

In the products of the disintegration of the schist and the itacolumite numerous rare minerals are found, and this is a subject of importance in connexion with our inquiry. First we have the diamond; then the euclase, a most rare and beautiful gem; and also the topaz, chrysolite, cymophane, transparent andalusite, tourmaline, amethyst, a beautiful variety of anatase, and rutile.

Diamonds are met with in three distinct regions. They are found, first, in what is called gurgulho, which is derived from the itacolumite, and consists of a pure quartzose sand. This sand is washed, and together with the diamond is obtained a residue of anatase, rutile, and magnetite or magnetic oxide of iron. These three minerals more or less constantly accompany the diamond, and are regarded as indications of its presence. Now, as the minerals associated with diamond are also found in the itacolumite, we might have concluded with tolerable certainty that the diamond existed in that rock and was derived from it; and that conclusion has been justified by recent, or comparatively recent, discoveries.

One observer has seen, we are told, four diamonds in the itacolumite in one spot—in the rock itself. Diamonds have actually been obtained by blasting the rock, showing clearly that the diamonds are there, and that the source of them is this rock. Then there is another variety of this weathered stuff derived from the metamorphic schist. As long as this superficial product of weathering, or gurgulho, yielded diamonds, the exploration of the subjacent schist was never thought of; but in 1850, by some chance or other, this schist was washed and produced many diamonds, and ever since it has been worked for the diamond. It appears that no diamonds have yet been discovered in the metamorphic schist itself; but that schist has been very imperfectly worked at present, compared with the itacolumite rock. The great point for us to bear in mind is the occurrence of diamond in this metamorphic schist. It is actually there *in situ*, so that no further doubt can be entertained on that point. In the Brazilian cascalho, Damour, a French observer, has mentioned the occurrence of disthene, felspar, almandine, hydrophosphate of alumina, titaniferous phosphate of yttria, diaspore, tantalite, columite, oxide of tin, cinnabar, and what to my mind is excessively interesting—graphite, another variety of allotropic carbon. Then we find gold diffused in the Brazilian diamond-bearing-schist, and also platinum. The association of gold with diamond is also a point of considerable importance, or, at all events, of interest.

Diamonds have been found, as we all know, in the Ural mountains since Humboldt's visit in 1829. He suggested the probability of their occurrence there from the geological similarity of the district to that of Brazil. You have all heard of the similar suggestion of the occurrence of gold in Australia, or a suggestion rather founded on similar reasoning. The diamonds are found in a stream work in the Ural mountains a foot and a half or two feet thick. Diamonds are said to have been found in a similar rock to itacolumite in North Carolina and Georgia, but I do not know how far that statement is worthy of acceptance. We are also told that diamond has been found in Australia. One has been brought over and presented to this museum by Sir Thomas Mitchell. There was some doubt at the time as to the source of the diamond, but the question has been taken up, and I think there is no doubt now with regard to the occurrence of diamond there. Public attention ought to be directed to the subject, in order that it may be investigated.

I might go on and expatiate for a long time with regard to the mode of the occurrence of diamond, but we have so much which remains to be done, that I must pass over that subject as briefly as possible, and now come to the conclusions and see if they are justified. The question is, if this itacolumite be, as there is no doubt it is, a rock of sedimentary origin, have the diamonds been developed in the rock by some means or other subsequent to its formation, or were they deposited there contemporaneously with it? That is the point, and so far as I know it is a point which has not been clearly made out at present. All attempts, I say, concerning the artificial production of diamond have hitherto proved most signally abortive. All that we are in a condition to say at present, so far as I know, is this—that we have not the slightest clue in the world to the mode in which the diamond has been made in nature. It is evident that the condition or conditions of its formation must be excessively rare, because the quantity of diamond is, comparatively speaking, so small. I cannot help thinking—and it is the opinion of those who have directed attention to this subject—that one day or other we shall be able to crystallise carbon. There can be little doubt about that; but then it does not follow, supposing we should arrive at that, that we should be able to crystallise diamonds of any value. It may be that the crystallisation of diamonds of a large size is a work of time—such a work as only nature can accomplish in a satisfactory way. No doubt fluorine, or some similar element, has played a part in the production of the diamond. It is a suggestion worthy of attention. Compounds of that element are very imperfectly known at present.

(To be continued.)

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, October 16, 1866.

Edward Schunk, *Ph.D., F.R.S., &c., President, in the Chair.*

A paper was read "*On the Ismorphism of Thallium-perchlorate with the potassium and Ammonium-perchlorates,*" by Prof. H. E. Roscoe, F.R.S., &c. (See page 217.)

"*Catalogue of Binary Stars, with Introductory Remarks,*" by A. Brothers, F.R.A.S.

PHYSICAL AND MATHEMATICAL SECTION.

October 11, 1866.

Joseph Baxendell, *F.R.A.S., Vice-President of the Section, in the Chair.*

"*Observation of the Eclipse of the Sun, October 8, 1866, at Mr. Worthington's Observatory, Crumpsall,*" by Joseph Baxendell, F.R.A.S.

The first contact was observed at 4h. 20m. 6·0s. Greenwich mean time. Owing to the low altitude of the sun, its limb was very tremulous, but the error arising from this cause was estimated not to exceed one second. The telescope used was the equatorially-mounted achromatic, of 5 inches aperture and 70 inches focal length, with a

positive eyepiece magnifying 68 times. The position of the observatory is, latitude 53° 30′ 50·0″ N., longitude 8′ 56·16″ W.

"*Results of a Comparison of the Magnitudes of the Bedford Catalogue with those of Sir John Herschel*," by George Knott, F.R.A.S. Communicated by Mr. Baxendell.

"*Note on the Combined Magnitude of two Stars in close Proximity*," by George Knott, F.R.A.S. Communicated by Mr. Baxendell.

ACADEMY OF SCIENCES.

October 29.

An elaborate paper on the "*Functions of Leaves*," by M. Boussingault, was the first read at the sitting on this day. This is a continuation of a paper by the same author, which appeared in the *Comptes Rendus*, vol. lxi., p. 657. It is devoted to a discussion of the comparative action of light on the opposite surfaces of a leaf placed in a mixture of air and carbonic acid. This appears to have been a debated question for nearly a century, for we find that Ingen-Housz, in 1780, fancied that the leaves of plants furnished a purer air if the sun shone upon their upper surface than when their lower surface received the direct influence of the sun. This conclusion was, however, premature, as the conditions of the experiment were not such as to admit of a decision one way or the other. The author proceeds to explain the conditions under which his experiments have now been tried, in order to obviate all possible source of error. He finds that in each experiment the under-surface of the leaf decomposed considerably more carbonic acid than the upper surface; in some instances the amount being nearly four times as much.

"*On a General Mode of crystallising Insoluble Compounds*," by M. E. Fremy. It occurred to the author that if he could effect, in a very slow manner, the precipitations and decompositions which in laboratories produce amorphous bodies, owing to the instantancity of their formation, he might succeed in obtaining them in the crystalline form. In some experiments the two bodies were introduced into liquids of different density, containing gum, sugar, gelatine, &c.; in others the phenomenon of endosmose was had recourse to; in other trials wood or unglazed vessels were employed: the result in almost all cases being that he obtained in the crystalline form such insoluble bodies as sulphate of baryta, sulphate of strontia, carbonate of baryta, carbonate of lead, sulphate of lead, oxalate of lime, borate of baryta, chromate of baryta, magnesia, and several sulphides. Quartz was attempted to be crystallised in a similar manner by the reaction of alkaline silicates on certain acids, but the author only succeeded in obtaining cystals which certainly would scratch glass, but contained 5 per cent. of soda and 27 per cent. of water.

"*On a Disengagement of Gas under Remarkable Circumstances*," by M. Babinet. When cold water is poured upon roasted and ground coffee, a considerable disengagement of gas takes place; this is probably air which has been absorbed after the manner of porous bodies, and is driven out by the water. The author finds that if a bottle is half filled with powdered coffee, then filled up with water and tightly corked, an explosion takes place. We don't quite see where the "remarkable circumstances" are, unless it be in the fact of such a trivial paper being brought before the French Academy.

"*Experimental Researches on the Development of Wheat*," by M. J. Isidore Pierre.

"*Remarks on a Recent Communication of M. Angström on certain Facts in Spectrum Analysis*," by M. Janssen. Our readers will remember that at the meeting of October 15 (Chemical News, p. 203) Angström corrected some of Janssen's statements. The latter now says that Angström's opinions entirely coincide with his own.

"*On the Cause and Nature of Tuberculosis*," by M. J. A. Villemin. The author finds that tuberculosis is a specific disease which is capable of being communicated from one animal to another by inoculation.

"*On the Habits of a Young Gorilla*," by M. de Langle.

NOTICES OF BOOKS.

The Student's Text-book of Electricity. By Henry M. Noad, Ph.D., F.R.S., F.C.S., Lecturer on Chemistry at St. George's Hospital. London: Lockwood and Co.

So rapidly is our knowledge of the science of electricity increasing, that books written on the subject a few years ago have now become insufficient, and a want has been felt for some work that should correctly represent the present state of the science. This want the book before us is intended to supply. Much of the matter has been taken from the author's "Manual of Electricity" and arranged in a more condensed form for the use of students, but many additions have been made throughout, and copious extracts have been taken from the "Cantor Lectures" which were delivered in the spring of the present year by Mr. Fleeming Jenkin, F.R.S. The whole is arranged in a very convenient manner, giving first the theory and laws of electricity and magnetism, and afterwards their application to telegraphy and other practical uses; the author has also adopted the plan of giving the principal facts and rules in large type, followed by illustrations and quotations bearing on the subject in smaller print, by which means much space is gained without any sacrifice of clearness.

The work is divided into ten parts, the headings of which are as follows:—Frictional Electricity—Magnetism — Electro-Physiology — Voltaic Electricity — Electro-Magnetism — Diamagnetism — Magneto-Electricity — Thermo-Electricity—Electric Telegraphy—and Miscellaneous Practical Applications of Electricity. As might be supposed, by far the greater number of the recent discoveries have been made in the two latter parts, and we therefore find allotted to them a much larger proportion of space than has usually been the case hitherto in treatises on electricity. The subject of electric telegraphy is divided into two chapters—Land Telegraphs, and Submarine Telegraphy. The former traces the history of all attempts to communicate by electricity down to the present time, giving a short description of all the early forms of apparatus designed for that purpose, and a full account of the various instruments that are now in practical use. The Morse instrument and its modifications are stated to be the most generally used of any, and a very complete description is therefore given of it, together with the alphabet; the latter, however, is certainly not the one that is commonly used at the present time. The chapter concludes with a long account of Professor Wheatstone's ingenious dial and automatic telegraphs. The description of the latter is chiefly taken from the Jurors' Report, International Exhibition of 1862; and this is, we believe, the first time an account of it has appeared in any manual of electricity. The chapter on Submarine Telegraphy commences with a list of all the principal cables yet made, their construction being illustrated by numerous diagrams. The Atlantic cable of last year is very completely described, both as to its mechanical and its electrical qualities, and an account given of the progress of the laying down to the loss of the cable on August 2, a note being inserted at the commencement of the book stating the facts of its successful recovery and the completion of this year's cable, with a short description of the latter. The subjects of induction and the retardation of signals are illustrated by numerous extracts from the valuable experiments of Mr. Latimer Clark (described in the Report of the Submarine Telegraph Committee), and frequent reference is made to Mr. Fleeming Jenkin's "Cantor Lectures" as to the best methods of testing cables for faults. Mr. Jenkin has also

contributed an account of Sir W. Thomson's portable electrometer, which is accompanied by diagrams of the different parts of the instrument, numbered for reference. The book concludes with a short notice of Mr. Wilde's new magneto-electric machine.

This work, we believe, will be found sufficient fully to enable the student of electricity to understand the later developments of the science, while the numerous diagrams will familiarise him with the construction and appearance of the principal instruments in practical use among electricians.

The Ophthalmic Review. Edited by J. Z. Laurence and T. Windsor. London: Hardwicke.

Our duty as reviewers is almost necessarily confined to announcing the punctual appearance of the October number of this excellent periodical. The present number opens with a good article on the necessity for a better provision for teaching ophthalmology in England, in the course of which there is given an anecdote from Trousseau's admirable Lectures on Quackery, which we are tempted to transcribe in full :—

"Quacks, it is sad to say, are often patronised by men of genius. I had the honour, for many years, to be the intimate friend and physician of Béranger. In 1848 he had a slight attack of ophthalmia, for which M. Bretonneau prescribed a lotion; the ophthalmia was cured, but as Béranger read and wrote a good deal, and as his skin was irritable, it returned. He consulted a Polish priest, who treated diseases of the eye by some secret remedy. At that time I was President of the Board charged with the examination of *officiers de santé*. The police had a crow to pluck with the Pole, on account of certain eyes that he had extinguished; and he, wishing to render himself safe, called upon Béranger and asked him to use his influence to get him passed at the examination, in order that he might go on treating eyes, and putting them out at his pleasure. Béranger came to me. 'My friend,' he said, 'will you do me a great favour? Try to get this poor devil licensed as an *officier de santé*. He only treats eye diseases; and, as your examinations embrace all branches of the healing art, have a little indulgence and show him favour. He is a refugee; and besides, he has cured me, which is the best of reasons.'

"I told him to send me his man. The Pole came. 'You are recommended to me,' said I, 'by one whom I should be very glad to oblige, one of my best friends, in fact by Béranger; which indeed says everything. Two of my colleagues, to whom I have spoken, agree with me to do what we can in your case. But, as our examinations are public, we must be careful. I will myself take the examination in anatomy; and, in order that it may not be difficult for you to know as much as I do myself, I will only question you upon the eye.'

"The man appeared disconcerted.

"I continued, 'You know what the eye is?'—'Of course I do.'

"'You know that there is an eyelid?'—'Certainly.'

"'You know what the pupil is?'—'Oh yes, I know it well.'

"'You have an idea which is the cornea?'—He hesitated.

"'Do you know the crystalline lens, the vitreous humour, or the retina?'—'No, Sir. Of what use would such knowledge be to me, who only occupy myself about diseases of the eye?'

"'It would be of some use, I assure you; and indeed it is almost necessary that you should have no doubt that there is a crystalline lens, especially if you mean to operate for cataract.'—'But I never operate.'

"'Still, if the fancy took you to extract one?'

"I could go no farther. The poor fellow wished to practise as an oculist without the slightest knowledge of the structure of the eye. I went to Béranger, and told him. He interrupted me by exclaiming—'But the poor man!'

"I continued, 'My dear Béranger, I have been your physician for eight years, and now I am going to ask for a fee.'—'What fee?'

"'You must write a song, and dedicate it to me; and I will furnish the subject.'—'Certainly, and the subject is?'

"'What fools are men of genius!'

"The affair was understood at once, and he said no more about the Polish priest."

We almost think that it would be possible to cap the above with an anecdote drawn from our own profession, in which the Polish priest might be replaced by the letters F.C.S.

CONTEMPORARY SCIENTIFIC PRESS.

[Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted.]

Bulletin de l'Académie des Sciences de Belgique. No. 5. May.

"*List of Prize Questions proposed by the Academy for 1867.*"

"*On some Derivatives of Paroxybenzoic Acid,*" by Ladenburg and Fitz.

No. 6. June.

"*On the Derivatives of Itaconic Acid and of Acids Isomeric with the same,*" by P. Swartz.

"*On the Organised Bodies found in the 'Terrain Ardennais'* (Dumont)," by C. Malaise.

"*On the New Variable Star discovered in Corona Borealis,*" by E. Quetelet.

No. 7. June.

"*On the Vision of Fish and the Amphibia,*" by F. Plateau.

"*On a Meteor observed in Belgium on the 20th of June, 1866,*" by A. Quetelet.

"*Note on the Mutual Action of Soluble Salts as compared with their Effect upon the Animal Economy,*" by L. H. Melsens.

No. 8. August.

"*On Coloured Glass Shades for lessening the Intensity of the Electric Light,*" by A. Brachet.

Sitzungsberichte der kaiserlichen Akademie der Wissenschaften zu Wien. No. 3. March.

"*On Electro-Magnetism as a Motive Power,*" by J. P. Waoner.

"*On the Radiant Heat which accompanies Fluorescence,*" by V. Pierre.

"*On the Colour of Daylight, and of some Sources of Artificial Illumination,*" by Memorsky.

"*Analyses of the Mineral Springs of Austria,*" by S. Streit and W. Holecek.

"*An Analysis of the Johannisbad Spring at Baden, near Vienna,*" by C. Hideoh.

"*On Sulphide of Allyl,*" by M. Ludwig.

No. 4. April.

"*On a New Method of measuring the Length of Waves of Light,*" by J. Stefan.

"*On the Influence of the Molecular Friction of Air on the Velocity of Sound,*" by the same author.

"*Experiments on Inflammation of the Stomach,*" by S. Stricker and Kocslakoff.

"*Experiments on the Interference of Light,*" by J. Stefan.

"*On some of the Dust Showers observed during the last few Years,*" by C. Jelinek.

Chemisches Central Blatt. Nos. 47, 48, 49, 50, 51, and 52.

Nos. 48 and 49 contain:—"*On the Determination of the Absorptive Power of Solid Bodies for Gases,*" by Dr. E. Reichardt. No. 49 contains:—"*Notice of the Nitrogenised Food of Plants,*" by Dr. W. Wolp and Professor W. Knop; "*On the Absorptive Properties of Arable Land,*" by W. Knop. Nos. 50, 51, and 52 contain a very long article on "*Researches on the Basic Carbonates,*" by A. Geuther and Dr. Brandes. No. 52 contains, besides, "*On the Corrosion of Lead in Water,*" by M. Stahlmann; "*On the Variations of Ash in different Potatoes,*" by Dr. A. Vogel.

NOTICES OF PATENTS.

No. 483. *Preparing Meat for Food.* Arthur Hill Hassall, M.D., Wimpole Street. Dated February 15, 1866.

This invention has for its object improvements in the preparation of meat for food. For this purpose the inventor selects the leanest joints or parts of beef or of any other kind of meat; these he first deprives of all bone, tendon, and visible fat, and the red part or flesh is then cut into pieces of about an inch or so in diameter. These are then passed through a sausage or mincing machine, by the knives of which they are cut into small pieces and minced. The minced meat is then spread in very thin layers upon perforated trays, by preference of galvanised iron; this spreading is effected either by hand labour, or it may be by a spreading apparatus attached to the mouth of the sausage machine. The trays when spread are transferred either to a drying closet heated by means of steam or to a hot-air room or chamber (heated by flues passing through it), in either of which the meat becomes deprived of the greater portion of its water and assumes a crisp and friable condition. Special care is taken that the meat is dried at a temperature below the coagulating point of albumen. The meat thus dried is then ground in a mill or under mill stones of suitable construction, after which it is passed either through sieves or a flour-dressing machine, a very fine "flour of meat" being thus obtained. This powder is now subjected to a further drying process, whereby the whole or nearly the whole of the water of the meat is dissipated. By preference, dry the greater portion, say about two-thirds of the powder, at a temperature below the coagulating point of albumen, and dry the remainder at a high temperature, say at about 160° Fahrenheit; the two portions are subsequently mixed together. By thus drying a portion of the powder at a higher temperature a superior flavour is imparted to the powder than if the whole of the powder were dried at a low temperature. For some purposes, however, the whole of the powder may at the second drying be dried at the low or high temperature; when intended to be used for biscuits at the low temperature, and when for lozenges at the high. Part of the ground meat will not after the first grinding be passed through the sieves or dressing machines. This has to be ground a second and even a third time, whereby other quantities of the flour are obtained, but there is still a residue which remains in the sieve. This is of a fibrous character, and consists for the most part of gelatine, and is derived from the membranous or gelatinous portions of the meat. This is ground in a mill suitably adapted for reducing fibre, or is subjected to a temperature much above the coagulating point of albumen, whereby it is rendered more friable, so that it admits of being ground and sieved, the powder being added to the flour of meat previously obtained. Finally, the bones are crushed, and these as well as the tendons are boiled and digested, so as to remove the gelatine contained in them, and which is subsequently recovered in the manner usually practised by gelatine manufacturers, and which, when reduced by grinding and sieving to a fine powder, is added to the flour of meat. Vegetables, such as turnips, carrots, celery, onions, and herbs, are dried also at low temperatures, and for the most part below the coagulating point of albumen, and they are then, like the meat powder itself, ground and passed through fine sieves, a "flour of vegetables" being thus obtained. If the flour of meat is intended to be used for the preparation of beef tea, add to it a little salt; if intended for soups, add all the requisite vegetables and flavourings prepared as above, and reduced to a fine powder similar to that of the meat itself, so that the cook has nothing more to do but to add the requisite quantity of water and simmer for a few minutes, when the soup is ready for use. The flour of meat is also suitable for being used in the preparation of a meat cocoa, also in the manufacture of meat biscuits, and also, when mixed with a farinaceous matter, for a food for invalids.

By the above-described method of preparing meat there is obtained a material capable of prolonged preservation; it utilises the beef or other meat which is usually thrown away in the preparation by the ordinary method of beef-tea, broths, and soups; it also reduces the meat to such a condition that the beef-teas and soups made with it are infinitely more nourishing than those made in the usual manner; and, lastly, it reduces the meat to such a state as that no mastication is required, and it can be readily consumed by persons with defective teeth and by invalids generally.

No. 580. *Liquid and Plastic Cement.* William Welch, Southsea. February 24, 1866.

A person, judging from many of the patents now in existence, would scarcely credit the possibility of any "invention" being too absurd to have protection granted it. Here, however, is an instance to the contrary, and we quote it as a warning to intending patentees that their discoveries must still contain a slight amount of sense and intelligibility.

The "invention has for its object the manufacture of liquid and plastic cement compositions, and relates also to the method of applying the same for ornamental and other uses. The cements are compounded from varied geological strata made subsidiary by mechanical and other means, or from substances artificially compacted in lieu thereof. The metallic or other substances thus produced are, by the aid of mineral acids, liquids, and salts, agglutinated into a plastic or fluid consistency, according to the purposes for which it is intended, and may be applied in the usual forms of ordinary paints or cements. The properties of the components are permanent and literally indestructible, and firmly adhering to metals, stone, wood, or other surfaces without being displaced by concussive or vibratory action (as is the case with ordinary cements when applied to non-absorbent bodies). The compositions are intended to be used for general, building, and other purposes, as also for imitations of stones, metals, &c., and for plastic ornamental purposes, also for the coating and preservation of iron and other substances exposed to marine uses, whereby a waterproof insulatory protective surface is obtained, and, where necessary, coated with a granulated or fluid metallic compound (pure or mixed), whereby a system of galvanism, active, passive, or otherwise, is produced for anti-fouling or other purposes."

After perusing this remarkable composition, our readers will hardly be surprised to learn that provisional protection was refused.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, Patent Agent, 54, Chancery Lane, W. C.

2625. E. B. Wilson, Edinburgh, "Improvements in furnaces."

2627. G. Hadfield, Lancaster, "Improvements in furnaces and cupolas."—Petition recorded Oct. 11, 1866.

2645. E. Beanes, Priory Road, Kilburn, "Improvements in refining or decolorising sugar and syrup."—Oct. 12, 1866.

2066. W. Clark, Chancery Lane, "Improvement in the utilisation of chloride of manganese (residue of the manufacture of chlorine) in the manufacture of peroxide of manganese, chlorine, and hydrochloric acid, and in apparatus for the same." A communication from E. A. Cotelle, 29, Boulevart St. Martin, Paris.—August 11, 1866.

2606. G. W. Skinner, Strand, "Improvements in the means of and apparatus for utilising sewage matters and liquids."

2612. G. H. Benson, Staleybridge, Cheshire, and W. G. Valentin, Royal College of Chemistry, "Improvements in the melting and casting of steel, and in the apparatus employed therein."

2614. G. H. Benson, Staleybridge, Cheshire, and W. G. Valentin, Royal College of Chemistry, "Improvements in the manufacture of malleable iron and steel, and in the apparatus employed in such manufacture."

2616. G. H. Benson, Staleybridge, Cheshire, and W. G. Valentin, Royal College of Chemistry, "Improvements in the manufacture of iron and steel, and in the apparatus employed therein."—October 9, 1866.

2669. G. T. Bousfield, Loughborough Park, Brixton, Surrey, "Improvements in the manufacture of green and blue colouring matters." A communication from A. Poirrier and C. Chappat, Rue d'Hauteville, Paris.

2671. A. Swan, Kirkcaldy, Fifeshire, "Improvements in, and in apparatus for, evaporating or recovering lees." October 16, 1866.

2681. J. Slessor, Glasgow, N.B., "Improvements in distilling alcoholic spirits."

2683. J. Hamilton, Glasgow, N.B., "A new and improved fuel."

2685. A. V. Newton, Chancery Lane, "Improvements in the process of distilling petroleum and other oils or substances." A communication from P. Lugo and T. O. L. Schrader, New York, U.S.A.—October 17, 1866.

2691.—A. R. F. N. Darbel, M.D., Rue d'Enghien, Paris, "Improvements in the manufacture of caustic soda."—October 18, 1866.

2707. E. L. Simpson, Bridgeport, Fairfield, Con., U.S.A., "An improved process for the preparation of india-rubber and kindred gums."—October 19, 1866.

Inventions Protected by the Deposit of Complete Specifications.

2759. G. T. Bousfield, Loughborough Park, Brixton, Surrey, "Improvements in the manufacture of gases for the purpose of producing heat, and the application thereof to metallurgical operations." A communication from W. Elmer, M.D., New York, U.S.A.—Petition recorded October 25, 1866.

2810. G. T. Bousfield, Loughborough Park, Brixton, Surrey, "Improvements in treating sheet-iron plates for the purpose of preparing the same for being coated with zinc, for producing the so-called 'galvanised iron,' and also for manufacturing such plate in imitation of Russia iron."—A communication from C. H. Perkins, Rhode Island, U.S.A.—October 30, 1866.

Notices to Proceed.

1654. D. A. Fyffe, Glammis, Forfarshire, N.B., "Improvements in the manufacture of pulp."

1658. J. Abbot, Dockhead, Surrey, "The better combustion of fuel in steam boilers and other furnaces."—Petition recorded June 20, 1866.

1667. E. Hunt, Glasgow, N.B., "Improvements in dissolving or treating rubber, gutta percha, copal, and similar gums or resins and their compounds."—June 22, 1866.

2418. C. Crump, Paignton, Devon, "Improvements in solvents for resins or resinous substances, caoutchouc, gutta percha, oils, and fats."—September 20, 1866.

CORRESPONDENCE.

Fires of Spontaneous Origin.

To the Editor of the Chemical News.

Sir,—Since the destruction by fire of the Standard Theatre on Sunday, October 21, I have not seen any reference made in the public prints to the probable cause of this accident, which forms one of a large series of similar disasters with which the British public is already familiar. Taking into consideration the known circumstances of the case—namely, the character of the theatrical performance, a burlesque of *Der Freischütz*, the time of outbreak, 6 a.m., and the unusual heat and closeness of the weather for some days previously, I conceive that the origin of the fire may with some degree of probability be attributed to the spontaneous inflammation of the pyrotechnic composition ordinarily used in the production of red fire. Several instances are already on record, and I was myself some five years ago witness to a spontaneous ignition of the substance in question. There cannot be a doubt regarding its highly dangerous character, and its liability to ignite spontaneously is specially noticed in Fownes's "Manual of Chemistry" (eighth edition, foot-note, page 284).

The red-fire composition ordinarily consists of nitrate of strontia, sulphur, chlorate of potash, and lamp-black, all in the state of fine powder, and intimately mixed; it is usually stored in metal canisters, but in the event of ignition occurring the vast quantity of gases evolved would at once rip open the cylinders and spread fire in all directions. I imagine that the tendency to become inflamed would be augmented by the heat of the weather, which from the *Times'* meteorological reports appears to have risen in London as much as thirteen degrees during the two days immediately preceding the conflagration. Large quantities of the "red fire" would no doubt be procured for a continuous representation of *Der Freischütz*, and inasmuch as similar performances are now going on at two other theatres in London, and the pantomime season is also fast approaching, it would seem desirable to call attention to the treacherous qualities of a pyrotechnic composition so largely employed. I am, &c. John Spiller.

Woolwich, November 5.

Process for the Estimation of Resin in Soap.

To the Editor of the Chemical News.

Sir,—As I happen, like your correspondent S. H. J., of last week's Chemical News, to have a text-book at my elbow, I was quite aware of the action of nitric acid on the fatty acids and the nine or ten acids of the acetic series, not to mention about half as many of the succinic, produced by that action; and when I made my first experiment for the estimation of resin, I was quite prepared to find that the process would not be satisfactory, on account of the action of the nitric acid on the fatty acids, as mentioned in Turner, Taylor and Brande, &c., but was agreeably surprised to find the result as near as a rough preliminary experiment could be expected to be. I then repeated the operation, and found my result to coincide exactly with the amount of fatty acid known to be present. I have made several experiments since, and in almost every case obtained a fair approximation to the relative proportions of the fatty and resinous acids. The reason of this I believe to be that nitric acid attacks the resinous much more readily than it does the fatty acids, producing almost at once a solution of the former as terebic acid, while the latter are comparatively unacted upon. That these fatty acids are but little acted on by the nitric acid during the operation is seen from the characteristic crystalline appearance of the cake obtained at the end of the process, and more especially from the high melting point exhibited, and which I found to be 118° F. This is, as near as may be, the correct melting point of such a

mixture of fatty acids as is usually obtained from mixed animal fats, and shows plainly that they have undergone but little alteration by the short continued action of the nitric acid. Had the results suggested by our friend S. H. J. been produced, the melting point of the resulting mixture of oily acids would have been depressed to at least 40° C., as several of those acids specified by him have melting points below zero; while the highest melting point is that of capric acid, the furthest down in the series, and which stands 86°. Moreover, in almost every instance I have found the resulting fatty acid to come up to the quantity actually present.

I never for a moment fancied that such a process as that given by me would, under all circumstances, give perfectly accurate results, but after a few experiments it is capable of giving results sufficiently correct for the purposes of the soap-maker, or even for the analyst, when required to give an idea of the relative proportions of fatty and resinous acids. The process is, I believe, capable of being elaborated into one giving thoroughly scientific results—say, by the precipitation of the terebic acid, or its collection in some other suitable manner—but this I leave to some one having better opportunities of scientific research.—I am, &c.

JNO. SUTHERLAND.

Soap Works, Sydney Street, Glasgow.

To the Editor of the CHEMICAL NEWS.

SIR,—In reference to the process proposed for the above by Mr. Sutherland, in your number for October 19, I beg to say, as a practical soap-maker, that a process of this kind is one of the great desiderata in soap analysis, but, as one who has had a laboratory training in London, and since then constantly engaged in analysing soaps for several years, I am bound to say that, having given the process several fair trials, under conditions slightly varied so as to afford greater chances of success, I fear there is no reliance to be placed on the process as thus described. I will not trouble you with the details of my experiments, which I should be happy to communicate to the author of the process, but will at once subscribe myself

Yours, &c. B.A., B.Sc. Lond.

The Smoke Question.

To the Editor of the CHEMICAL NEWS.

SIR,—I have read a paper in your journal by P. Spence, Esq., F.C.S., in which are the following statements:—

1st. That well-known gas nitrogen is "thoroughly poisonous to animal life."

2nd. That fresh charcoal is newly-*precipitated* carbon.

3rd. That when 50,000 tons of coal containing 80 per cent. of carbon are burnt, 183,000 tons of CO_2 are formed, whereas with the above data most persons would calculate 146,666 tons; thus:—

$$\frac{50000 \times 80 \times 22}{100 \times 6} = \frac{88000000}{600} = 146666$$

Mr. Spence, however, obtains a different result, and this 183,000 happens to represent in round numbers the weight in tons of the CO_2 which would be produced by the combustion of 50,000 tons of pure carbon; thus:—

$$\frac{50000 \times 22}{6} = \frac{1100000}{6} = 183333.$$

4th. That "at present we get not much, if anything, over half the available heat" of coal. Now, in your report of Dr. Frankland's lecture on the source of muscular power, it is stated (and I have seen it proved at length elsewhere) that "in the best constructed steam-engine only one-tenth of the actual energy developed by the burning fuel can be obtained in the form of mechanical power" (CHEMICAL NEWS, vol. xiv., page 150).

I am, &c. W. T.

November 3 1866.

MISCELLANEOUS.

Chemical Society.—The next meeting of the Society will be held on Thursday evening, at 8 o'clock, when the following papers will be read:—"*On Ozone*," by Dr. Daubeny; "*On a Chlorosulphide of Carbon*," by Mr. W. N. Hartley.

Carminic Acid, according to MM. Hlasiwetz and Grabowsky, is a glucoside, decomposing by boiling with diluted sulphuric acid, the products being glucose and *carmine red*. Melted with hydrate of potash, the latter gives a new compound, crystallisable in yellow plates, which the author calls coccinine. It is remarkable for the beautiful coloration it produces with different reagents.—*Zeitschr. Chem.*, 1866, p. 373.

Physiological Action of Nitrate of Methyl-Strychnine.—M. Schroff has confirmed the curious fact noticed by M. Stahlsmidt of the perfect harmlessness of methyl-strychnine when introduced into the blood; but he finds that its action is different when this base is put into direct communication with the blood by subcutaneous injection; for in this case it recovers the poisonous properties which characterise strychnine. This reminds the author of the action of curara, which is similarly digested without danger, and he asks whether this Indian arrow poison may not be of an analogous nature. The experiments have been made on rabbits and frogs.—*Neu. Repertor.*, xv. 196.

Permanganate of Potash, in solutions, spread upon pear or cherry wood for a few minutes, leaves a permanent dark brown colour, which, after washing, drying, and oiling, assumes a reddish tint upon being polished.—*Am. Drug. Circ.*

ANSWERS TO CORRESPONDENTS.

General Index to the First Fourteen Volumes of the CHEMICAL NEWS.—We have had an inquiry for such an index. Its compilation will be attended with considerable trouble and expense; if, however, we find our readers generally wish for one, it shall be commenced as soon as the present volume is completed. Intending subscribers will please notify their wishes to the publisher without delay.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

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Amber Mouthpiece.—Baudrimont certainly found sulphur in all specimens of amber which he examined, but we see no apparent connexion between this sulphur and the sore lips you complain of. We should rather blame the tobacco.

Q. R. S.—We suggested the employment of silico-tungstate of soda for fluid prisms in our number for May 14, 1864, but we do not know whether the suggestion has ever been adopted.

Photo.—Add sulphide of sodium to your silver solution, and the whole of the metal will be precipitated as sulphide. You will get no precipitate on the addition of salt, as chloride of silver is soluble in hyposulphite of soda.

A Consumer will find a method of detecting picrotoxine (the poisonous principle of Cocculus indicus) in beer in the CHEMICAL NEWS, vol. ix., p. 122.

Received with thanks.—J. M. M.; Prof. How, D.C.L.

Books Received.—Temperature in Acute Disease, by Thomas A. Compton, M.D., &c.; Calendar of the Pharmaceutical Society of Great Britain; A Popular Description of the Small Induction Coil.

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AND

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

An Introduction to Chemical Philosophy, according to the Modern Theories, by Adolphe Wurtz, *F.R.S.*

Part III.

Connexion between Organic and Inorganic Chemistry.

Section V.—*Inorganic and Organic Nitrides.*

(*Continued from page 218.*)

Oxygenised groups, inorganic and organic, may replace the hydrogen of ammonia to form compound ammonias or amines. I have shown the existence of oxyethylenic bases, which may be looked upon as ammonia, in which 1, 2, or 3 atoms of hydrogen are replaced by 1, 2, or 3 oxyethylic groups $\dot{C}_2H_3O$. This group acts the part of a monatomic radical; it may be looked upon as formed of an ethylene group joined to the residue $(H\dot{O})'$.*

$$[(\dot{C}_2H_4)''(H\dot{O})']'.$$

The atomicity of the ethylene group is lowered one degree by the addition of the monatomic group $(H\dot{O})'$.

The following formulæ express the relations of these bases with ammonia:—

$$\left.\begin{matrix}\dot{C}_2H_3O\\ H\\ H\end{matrix}\right\}N, \qquad \left.\begin{matrix}\dot{C}_2H_3O\\ \dot{C}_2H_3O\\ H\end{matrix}\right\}N, \qquad \left.\begin{matrix}\dot{C}_2H_3O\\ \dot{C}_2H_3O\\ \dot{C}_2H_3O\end{matrix}\right\}N.$$

Oxethylenamine. Dioxethylenamine. Trioxethylenamine.

There are oxycobaltic, oxymercuric, and oxyplatinic bases.

We know that the ammoniacal solutions of the salts of cobaltosonium absorb the oxygen of the air and change into ammoniacal bases corresponding to cobaltic oxide. These bases have been studied (within the last few years) by M. Fremy and by MM. Gibbs and Genth. M. H. Schiff rightly admits the existence in them of a group $[\dot{C}oO]'$. He considers this group as monatomic, and formed by the combination of diatomic oxygen with cobalt ($\dot{C}o=59$), which is triatomic in the cobaltic salts (cobalticum). Here we see the atomicity of the triatomic metal lowered two degrees by the addition of oxygen, which saturates 2 affinities:—

$$[\dot{C}o'''\dot{O}'']'.$$

We know that there are oxygenised salts corresponding to the combinations of chloroplatammonium and of amichloroplatammonium. These are formed when the chlorised combinations are boiled with an excess of nitrate of silver (Gerhardt, Kolbe). The chlorine of the chloroplatinum radical is then replaced by oxygen.

$$\left.\begin{matrix}[PtCl_2]''\\ H_2\\ H_2\\ H_2\end{matrix}\right\}N_2 \qquad \left.\begin{matrix}(Pt\dot{O})''\\ H_2\\ H_2\\ H_2\end{matrix}\right\}N_2$$

Chloroplatammonium. Oxyplatammonium (Gerhardt).

$$\left.\begin{matrix}(PtCl_2)''\\ Am_2\\ H_2\\ H_2\end{matrix}\right\}N_2 \qquad \left.\begin{matrix}(Pt\dot{O})''\\ Am_2\\ H_2\\ H_2\end{matrix}\right\}N.$$

Amichloroplatammonium. Amoxyplatammonium (Kolbe).

In these bases the group

$$Pt\dot{O}$$

acts as a diatomic radical formed by the combination of diatomic oxygen with tetratomic platinum.

M. Millon some years ago discovered a remarkable base, to which he gave the name of *ammonio-mercuric oxide*. This body is formed by the action of ammonia upon oxide of mercury. Its composition is usually represented by the formula

$$3HgO,HgH_2N+3HO.$$

When anhydrous it contains—

$$3HgO,HgNH_2.$$

In our notation this formula becomes

$$3Hg\dot{O},HgN_2H_4.$$

The base itself may be looked upon as the oxide of an ammonium—

$$\left[\left.\begin{matrix}(Hg.H\dot{O})\\ Hg''\\ H\end{matrix}\right\}N\right]_2\dot{O}$$

in which the diatomic mercury would be joined to the $H\dot{O}$ group, as, in the oxyethylammoniums, ethylene is joined to the same group.

(To be continued.)

New Researches on the Law of Chemical Proportions, and on Atomic Weights and their Mutual Relations, by J. S. Stas.*

(*Continued from page 219.*)

In my third memoir, entitled "*Researches made for the purpose of determining and controlling the Atomic Weights of Nitrogen, Bromine, Chlorine, Silver, Lithium, Potassium, and Sodium,*" are recorded all the labours to which I have devoted myself in order to solve these different questions. This memoir consists of fifteen notices; it is useless to quote them all here. The principal are entitled—5th. *Of chloride of potassium employed in the determinations and determination of the proportional relation between chloride and nitrate of potassium;* 7th. *Of chloride of sodium used in the determinations and determination of the proportional relation between this chloride and nitrate of sodium;* 9th. *Of chloride of lithium employed in the determinations;* 11th. *Of the means employed for the determination of the proportional relation between chloride of lithium and silver;* 13th. *Of the means employed for the determination of the proportional relation between chloride and nitrate of lithium;* 14th. *New syntheses of nitrate of silver.*

The remarkably concordant results to which the labours mentioned in these notices lead me, show that, taking for the atomic weight of potassium 39·00, or 39·125, or 39·250; of sodium 23·00; of lithium 7·00; of silver 108·00, the difference between the weight of a molecule of the chloride of one of these metals and the nitrate which corresponds to it is not a *constant*, as it ought to be, according to the law of chemical proportions, and further that it is not equal to 26·50.

Indeed, for potassium, according as K is taken at 39·00 or 39·125, or 39·250, this difference is comprised between . . .	26·553 and 26·640
For sodium this difference is .	26·561
For lithium	26·603
For silver	26·607
Instead	26·500

These researches prove, on the contrary, that the difference becomes a constant from the moment when (in order to calculate the results) *those deduced directly from the experiment*, and not the hypothetical ciphers, are taken for atomic weights.

* The group $[\dot{C}_2H_4.H\dot{O}]'$ represents glycol. $\dot{C}_2H_4.2H\dot{O}$ minus $(H\dot{O})'$.

* *Memoirs of the Royal Academy of Belgium.*

In this case, chlorine being 35·457, and

K =	39·130,	the difference is equal to	.	26·586
Na =	23·043	,, ,, ,,	.	26·591
Li =	7·022	,, ,, ,,	.	26·589
Ag =	107·930	,, ,, ,,	.	26·587

This constant is then equal to a mean of . 26·588

There is, then, a difference of $\frac{1}{265}$th over the total weight of the constant, or nearly $\frac{1}{10}$th of an atom of hydrogen, which serves as the unit, between the calculation and the result of the concordant experiments, in which, nevertheless, *four* distinct metals are interposed, three of which are the best known of all existing elements. This difference constitutes an error *sixteen* times greater than the mean deviation which I have observed in my experiments on chloride of potassium; it is *twelve* times greater than the mean deviation proved in the experiments on chloride of sodium, a determination of which has been made in collaboration with M. Kekulé; it shows an error *forty* times greater than the mean deviation of the proportional relation between chloride and nitrate of lithium which my determinations present; lastly, this difference constitutes an error *forty* times greater than the mean deviation offered by my new synthesis of nitrate of silver.

The magnitude of the difference between the calculation, according to Prout's hypothesis, and the experiment, proceeds from this—that, in this method of control, the deviation existing between the atomic weights of chlorine and nitrogen, calculated according to this hypothesis, and the atomic weights deduced from experimental determinations, and which is in an opposite direction, is added, instead of taken off, as is often the case in other modes of investigation. Relatively slight as is the difference for each of these two bodies, it becomes so great when added, that it is absolutely impossible to attribute it to a constant error of observation. The sum of the mean deviation which exists, for chlorine and nitrogen, between the figures of the hypothesis and those which proceed from the experiments recorded in my "*Researches on the Reciprocal Relation of Atomic Weights*," is from 0·084 to 0·086, or nearly $\frac{1}{10}$th of an atom of hydrogen, a sum which, within the limits of accuracy of the experiment, is equal to the overplus observed in the transformation of chlorides into nitrates. I confess this was the motive that induced me to undertake those *four series* of researches in which (as I anticipated) I had to struggle with such considerable difficulties of every kind, that several times I was on the point of giving them up. As for the rest, I explain myself at length on this subject in the exposition of these researches.

The atomic weight of nitrogen which is derived from these labours is, according to the relation of weight—

From chloride of potassium to nitrate .	= 14·043
From chloride of sodium to nitrate . .	= 14·048
From chloride of lithium to nitrate . .	= 14·046
From chloride of silver to nitrate . .	= 14·044
Mean . . .	14·045

There is, then, a mean deviation which does not exceed $\frac{1}{1000}$th part.

My *new* syntheses of nitrate of silver lead to .	14·042
My *old* syntheses, contained in my "*Researches on the Reciprocal Relation of Atomic Weights*," give as a mean	14·041
General mean . .	14·044

These labours, then, completely confirm the conclusion which I have drawn from the synthesis of nitrate of silver; they establish on sufficient proof that the atomic weight of nitrogen is not represented by 14·00, oxygen being 16·00, and that the hypothesis on which this number is based is not founded on experience.

These labours prove equally that—

1st. The atomic weight of potassium is comprised between .	39·130	and	39·135
2nd. The atomic weight of sodium is between . . .	23·042	,,	23·045
3rd. The atomic weight of lithium is between	7·020	,,	7·024
4th. The atomic weight of silver is between	107·925	,,	107·930
5th. The atomic weight of chlorine is between . . .	35·455	,,	35·460

Before the publication of my "*Researches on the Reciprocal Relation of Atomic Weights*," I had many times determined the proportional relation between bromide of potassium and silver. The labours which I effected in order to obtain pure bromine designed for the synthesis of bromide of silver, and those which I undertook for the purpose of proving the purity of the bromine produced, compelled me to procure very considerable quantities of bromate and bromide of potassium. I took advantage of this circumstance to control the atomic weights of potassium and bromine. The *ensemble* of the researches which I have made on this subject is recorded in the notice which closes the third memoir, and which is entitled, "*Determination of the Proportional Relation between Bromide of Potassium and Silver.*"

From the relations proved between bromine, potassium, and silver, it follows that silver being .			107·93
The atomic weight of potassium is comprised between . .	39·130	and	39·144
The atomic weight of bromine . between	79·945	,,	79·965

The researches made by M. Marignac in 1843 lead to precisely the same numerical proportions.

(To be continued.)

PHARMACY, TOXICOLOGY, &c.

Report on Amyl,* *by Dr.* B. W. RICHARDSON.

THE author commenced by stating that, in accordance with the desire of the Section, as expressed at the last meeting at Birmingham, he had in this, his third report, enlarged the report by introducing a comparison between certain of the compounds of ethyl and those of amyl. After recapitulating his reports of previous years, the author narrated experiments to ascertain whether nitrite of amyl could, by being injected into the blood-vessels, recall the heart into action when that organ had ceased to beat from various causes of sudden death, such as death by drowning or by suffocation from poisonous vapours and the like: the results were, so far, negative, but this probably arose from the want of some advance in experiment rather than from an error in principle.

In the next step of his Report Dr. Richardson explained that the extreme stimulation and action of the heart which follows on the inhalation of nitrite of amyl is brought about by the direct action upon the heart through the nervous system. The experience of every-day life tells us that the heart may be thrown into similar activity by the mere agency of force communicated from the external world to the senses, and through

* British Association, Nottingham Meeting, Section D.

them to the heart. The influence of sounds harsh or melodious, of sights appalling or fascinating, are well known. From the manner in which these influences come upon us, from their invisibility of action—if such an expression be allowed—we are prone to look upon them as immaterial agencies; they are not so; thoroughly understood, they are as material as a physical blow, or the impress of a liquid or gaseous substance. Nitrite of amyl is one of those substances which enable us to realise this connexion between the really material and seemingly immaterial influences which surround us; for, by refining experiment so as to diffuse vapour of amyl through the air, an invisible and, as it would seem to the unlearned, an immaterial agency acts, by known rules and in obedience to the human will. He (the author) could, for instance, make every person's heart in the room quicken ten beats per minute as easily as he could quicken the action of a steam-engine if his hand were on the lever.

The third point dwelt upon had reference to the antiseptic properties of the amyl compounds. It was shown on this point that the acetate of amyl (essence of pears) was an excellent and cheap antiseptic, that it might be applied to the preservation of animal substances used as food, and even for the transmission of whole carcases of animals from one part of the world to the other.

The fourth point dwelt upon related to the physiological action of pure ether, acetic ether, hydrochloric ether, and nitrite of ethyl. The inferences drawn from the author's researches were strongly in favour of pure ether, as a means of destroying pain generally, over chloroform and all other similar bodies.

Respecting nitrite of ethyl, specimens of which were shown, it was reported that this substance, like nitrite of amyl, was one of the most powerful of excitants upon the heart. It also suspended the animation of cold-blooded, and, to a certain limited extent, of warm-blooded animals.

The author concluded with the statement of the three following conclusions:—

1. That the oxide of ethyl, when used as a pure chemical, is the safest and most effective general means for producing insensibility to pain.

2. That amylene and ether produce their effects by virtue of two acts: by suppressing oxidation of blood in the lungs and by the extraction of caloric from the blood. This latter point was advanced as a new and more simple explanation of the action of the substances named than had before been suggested.

3. That the modification of symptoms produced by the change of form of a simple amyl or ethyl compound into a nitrite, turned in the introduction of nitrogen, into the composition; by this introduction the anæsthetic action is destroyed, and is replaced by disturbance of muscular action, especially of the heart. In this respect the nitrite compounds represent immediately in an exaggerated degree the action of strychnine, theine, nicotine, and analogous alkaloidal substances, of which nitrogen forms an elementary constituent.

Cafetannic Acid, according to M. Hlasiwetz, is a glucoside resembling tannin, and may be transformed into glucose and a crystallisable acid $C_{18}H_{16}O_8$, which the author calls *cafeic* acid. This new acid is allied to *ferulic* acid, previously discovered in assafœtida by M. Hlasiwetz, as well as to protocatechuic acid.—*Zeitschr. Chem.*, ix. 373.

REPORT ON THE

CHEMICAL LABORATORIES

IN COURSE OF ERECTION IN THE

UNIVERSITIES OF BONN AND BERLIN.

The Chemical Laboratories of the Rhenish Frederick William University of Bonn.

(*Continued from page* 221.)

The Basement.

We will take but a hasty survey of the plan of the basement (Fig. 3, page 232). This is, to all intents and purposes, a repetition of the ground floor, the greater thickness of the walls, however, lessening the amount of space to some extent. The rooms in this part of the building are twelve feet in height from the floor to the top of the arch, and are sufficiently lighted throughout by numerous windows of comparatively large dimensions. As yet, only part of the basement has been assigned to special purposes.

In the plan of the basement the various parts are again denoted by letters, enabling the reader to trace the several rooms in the synopsis, in which full particulars of their destination and of their dimensions are given.

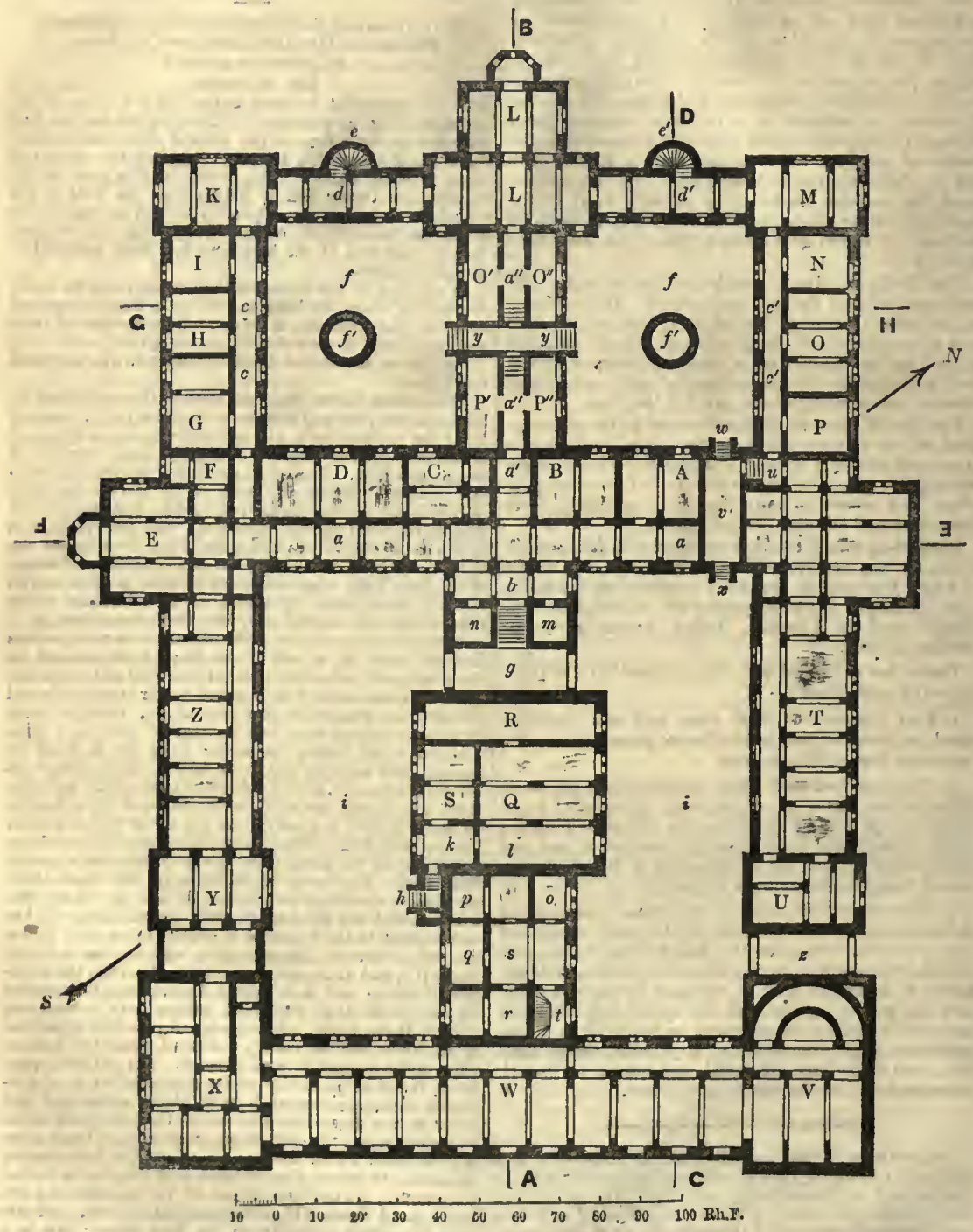
For further elucidation the following remarks may still find a place.

The various rooms are connected with one another by means of the principal transverse Corridor (*a*, *a*), running along the whole length of the middle cross building, and lying immediately under the corresponding corridor of the ground floor. These two corridors communicate with one another by means of a Staircase (*b*), the bottom flight of which lies directly under that leading from the ground floor to the great theatre, whilst the two side wings, into which it divides at the mid-story, lead, close beside the theatre staircase, to the ground-floor corridor, affording, at the same time, communication between the two stories and the front courts by means of an additional flight descending from the mid story into the thoroughfare (*g*).

Along the main corridor of the basement are two spacious Rooms (A and B), of which the first (A) is intended for the Storage of Solid, the other (B) for that of Liquid Reagents. In the first of these rooms (A) are cupboards and drawers for preserving dry substances, together with shelves for earthenware jars containing moist and deliquescent salts; whilst the second room (B) is fitted for storing away carboys, and stone jars wherein acids, soda solution, ammonia, and liquid reagents generally are kept. Both store rooms are close to the flight of stairs leading on one side into the courts, on the other to the ground floor, whereby the carriage of chemicals to the store rooms and thence to the main body of the institution is greatly facilitated. The same accessibility to the floor above pertains to the other two rooms (C and D) along this corridor, and has determined their especial uses. In the one nearest to the staircase a steam boiler will be set up; while directly communicating with the Steam Boiler Room (C), and at the same time accessible from the corridor, is a large and well-lighted Apartment (D) intended for rougher kinds of work, and especially to be used as a general Wash Room, where glass and porcelain apparatus of all kinds can be readily collected from the various parts of the institution and cleaned. For all these purposes the close proximity of the steam boiler is of particular advantage, inasmuch as it places steam and hot water at the immediate disposal of those engaged in the adjoining room. In this room, moreover, a large press will be fitted up, in the use of which for hot-pressing purposes, the steam, close at hand, may likewise be turned to account. At the extreme end of the corridor is a fine well-lighted Room (E), corresponding in form and size with the director's study on the floor above; this is a Store Room for the large stock of Glass and Porcelain,

Fig. 3.

Rooms on Basement.



under the charge of the castellan. In the Lumber Room (F) immediately adjoining, boxes and packages in which glass and porcelain as well as other supplies for the institution have arrived, can be temporarily stowed away.

SYNOPSIS OF ROOMS ON BASEMENT.

	Name of Room.	Length. ft.	in.	Breadth. ft.	in.	Height to top of arch ft.	in.
A	Store-room for solid reagents	19	4	15	11		
B	Store-room for liquid reagents	18	11	15	11		
C	Steam boiler and press-room	18	11	15	11		
D	Wash-room for glass and porcelain	33	1	15	11		
E	Store-room for glass and porcelain	26	5	19	1		
F	Lumber-room for temporary storage of boxes and packages	8 7	9½ 0	15 4	11 10		
G	Coal-cellar for steam boiler and hot-water apparatus	21	5½	15	5½		
H	Room for hot-water apparatus	16	8	15	5½		
I	Hospital for animals under chemico-physiological treatment	12	5½	15	5½		
K	Laboratory of physiological chemistry	25	6	14	11	12	0
L, L	Furnace-rooms of second and third laboratory	37 21	7 11	14 15	11 7		
M	Furnace room of first laboratory	25	6	14	11		
N	Room for hot-water apparatus	12	5½	15	5½		
O	Coal-cellar	25	8	15	5½		
P	Ditto	12	5½	15	5½		
O′	Ditto						
O″	Ditto						
P′	Ditto	21	3	7	1½		
P‴	Ditto						
Q	Workshop	29	8	25	8		
R	Room for medico-legal investigations	39	11	8	11½		
S	Cellar for explosive compounds, condensed gases, &c.	19	4	12	10		
T, U, V, W, X, Y, Z	Cellarage provided for future use	...		...		...	
a, *a*	Main corridor through middle cross building	122	5½	8	9		
a′	Middle widening of corridor (*a*, *a*)	15	11	9	0	12	0
a″	Passage connecting the widening (*a′*) of main corridor with great furnace-room	21	3	5	0		
b	Staircase from basement to ground floor	...		...		...	
c, *c*	Side passage leading to laboratory of physiological chemistry	53	3	4	8½		
c′, *c′*	Side passage leading to small furnace-room	53	3	4	8½		
d	Passage between laboratory of physiological chemistry and furnace-room of second and third laboratories	36	5	10	0	12	0
d′	Passage between the furnace room of second and third laboratories and that of first laboratory	36	5	10	0		
e	Winding staircase of passage (*d*) to open hall above	...		...		...	
e′	Winding staircase of passage (*d′*) to open hall above	...		...		...	
f, *f*	Back courts of the institution	56	1	46	10		
f′, *f′*	Open reservoirs in back courts	...		...		...	
g	Thoroughfare between front courts of institution	29	2	9	0	...	
h	Steps leading from basement to front court, and thence to platform outside lecture preparation room	...		...		...	
i, *i*	Front courts of institution	115	6	45	0	...	
k	Approach to rooms under the lecture hall	12	10	8	11½	12	0
l	Ventilation niche for galvanic battery	...		...		...	
m, *n*	Coal-cellars	11	10	6	11½		
o	Director's household cellars	11	4	7	8½		
p		16	11½	11	4		
q		13	2½	7	3½	12	0
r		16	11½	11	7½		
s	Approach to director's household cellars	16	11½	13	2½		
t	Servants' staircase from front court to director's residence	...		...		...	
u	Staircase from side passage (*c′*, *c′*) to thoroughfare (*v*)	...		...		...	
v	Thoroughfare between front court (*i*) and back court (*f*)	26	5	9	0	12	0
w	Steps from thoroughfare (*v*) to back court	...		...		...	
x	Steps from thoroughfare (*v*) to front courts	...		...		...	
y, *y*	Thoroughfare between back courts	22	0	7	3	12	0
z	Carriage-way to courts	25	6	11	0		

From the main corridor (*a*, *a*), between the lumber room and the wash room, a Side Passage (*c*, *c*) branches out, communicating on its left side with three small Rooms (G, H, I), and forming at the end an approach to a larger Room (K). The first of the small rooms, the one lying nearest to the main corridor, is a Coal-cellar (G) for supplying the steam boiler as well as the hot water apparatus in the adjoining room (H). The two rooms next in succession are provided for chemico-physiological researches; the large well-lighted room at the end being the Laboratory for Physiological Chemistry (K), whilst the adjoining room is fitted up as a Stable (I) for the housing and feeding of animals required for experiment. The chief entrance to this laboratory, however, is not from that side by which we have come upon it in our wanderings through the basement. It is likewise approached from the other side by a Passage (*d*) communicating with the open hall overhead by means of the Spiral Staircase (*e*), so that any one working in the second or third laboratory need only pass through the adjoining operation room to reach in this way the laboratory for chemico-physiological researches.

In addition to this laboratory, the basement of the back block of the building contains two Furnace Rooms (L, L, and M) for smelting operations, carried on by means of coal and coke. The larger of these, that situated in the middle (L, L), is for students of the second and third laboratories; while the smaller one (M) is for the beginners. These furnace rooms are purposely located in the basement, since the greater height of the chimneys of this flat insures a considerable increase of draught. Being, moreover, far less frequently used than the rooms on the ground-floor, their slight distance from the principal laboratories appeared of but little importance. Lastly, the dust and dirt invariably attending the use of coal are thus almost entirely excluded from the rooms in the flat above. The furnaces and appliances set up in these laboratories are of a varied nature; among them protected niches for operations carried on under great pressure, such as digestion of substances in sealed tubes, &c., deserve particular notice.

The larger furnace-room is readily accessible from all the laboratories on the ground-floor, first by the corridor leading to the laboratory for physiological chemistry, and the spiral staircase connected therewith, and secondly by the Passage (d') leading to the small furnace-room, from which a Spiral Staircase (e') likewise ascends to the open hall above. By the same route, the beginners working in the first laboratory get to the smaller furnace-room allotted to their use. The large furnace-room communicates, moreover, by a special Passage (a'', a'') with the Widening (a') of the principal corridor of the basement, and thence with the various store-rooms. For the storage of the fuel required for the furnace operations, four Coal Cellars (O', O'', P', P'') have been provided in the immediate neighbourhood of, and communicating with, the passage (a'', a''). Lastly, the Back Courts (f) of the building are also made accessible from this part by means of a Thoroughfare (y, y) connecting the two courts by intersecting the passage (a'', a'') in the mid-length.

The furnace-room for beginners has in like manner its own Passage (c', c') communicating with the basement rooms of the middle cross building. The Rooms (N, O, P) lying along the passage are for Hot-water Apparatus (N) and for Storage of Coal (O, P), which is thrown in here from the outer and consequently most accessible side of the building. The end of the passage (c', c') opposite the entrance to the small furnace-room opens, on the one hand, into the cellars which, having as yet no special purpose assigned to them, have been left unfinished, and leads, on the other hand, by a small Flight of Steps (u) down into the Thoroughfare (v), from which by means of two other Flights (w and x) we ascend to the left front and back courts.

With regard to the courts themselves, it deserves to be mentioned that the two Front Courts (i, i) communicate by means of a Thoroughfare (y) cutting the front wing of the cross building immediately under the landing of the theatre staircase; in this manner any one of the four courts can be reached through the Carriage-way (z) facing the town, without entering the interior of the building. Such a disposition is of great use for the preservation of cleanliness throughout, and of absolute necessity for rendering all parts of the building accessible in case of fire.

Attention must still be directed to some of the rooms situated on the basement of the front part of the middle wing.

The Staircase (h), already mentioned when describing the room for preparing the lectures on the ground floor, has the double office of uniting the two floors and furnishing to the lecture assistant a ready exit into the front court. On descending from the ground floor to the basement, we pass through the Vestibule (k) into a large Workshop (Q) lighted by three windows. Here the rougher work required for the lectures is performed; here liquid carbonic acid would be prepared, and here, in a well-ventilated Niche (l), stands the large galvanic battery already mentioned, the wires of which, passing through the floor of the theatre above, communicate with the electric lamp, now rapidly becoming an indispensable appliance of the lecture table. Further on is a small Laboratory (R) for Medico-legal investigations; it is lighted from both sides, and, being accessible only to the director and the lecture assistant, is effectually protected from all intrusion. Beside the room for the rougher lecture work there is a small Cellar (S), communicating with the vestibule, in which compounds requiring a low temperature, explosive bodies, such as gases condensed in hermetically sealed tubes, like sulphurous acid, chlorine, &c., are preserved. Substances readily undergoing decomposition, generating corrosive vapours, or in any way dangerous, can thus be conveniently excluded from the general collection.

Besides the rooms enumerated there are no other rooms devoted to the purposes of the institution. The architect, with his accustomed foresight, has not, however, forgotten to assign the necessary cellarage to the director's household. These Cellars (o, p, q, r), completely shut off from the institution, surround a Vestibule (s) which by means of a special Back Staircase (t) is connected with the residence in the upper floor.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

ROYAL SCHOOL OF MINES, MUSEUM OF PRACTICAL GEOLOGY.

A Course of Twelve Lectures on Chemical Geology, by Dr. Percy, F.R.S.

Lecture No. X.

(Continued from page 223.)

The next variety of carbon with which we shall deal is graphite. Graphite derives its name from a Greek word signifying *to write*. You all know graphite under the familiar term of plumbago or black lead. It is an elementary body—pure carbon, in fact. It crystallises in the rhombohedral system, whereas the diamond, the other variety of carbon, crystallises in the cubical system. Graphite is perfectly opaque, and exceedingly difficult of combustion compared with ordinary charcoal. It is characterised by giving that well-known stain to paper—a stain, however, which it alone does not give. It is very similar to specular iron ore, and I have seen a quantity of that stuff sold at works as plumbago for lubricating purposes, and the mistake was not found out. We make graphite artificially to a great extent, and it is made every day in our iron furnaces on a large scale. The condition is this: If we heat iron in contact with carbonaceous matter to a very high temperature, and let there be an excess of carbon, we always get graphite formed. That graphite may separate to a certain extent in the crucible in which you make the experiment; if not, you will always find it more or less diffused through the iron itself, if the experiment be properly conducted, and you get it by acting on the iron (grey pig iron) by hydrochloric acid, and then treating the residue by various other reagents. At length you obtain scales of pure graphite. This graphite is separated from its combination with iron, or from its solution in iron, on the solidification of the metal, just as any other crystal would separate from a solution during solidification or cooling. Iron certainly has the power of dissolving carbon, and when the carbon separates, if it separates at all, it is always in the crystalline form of graphite. You may take that as a general—nay, universal rule. I think the solubility of graphite in iron is proportionate, to a certain extent, to the temperature. Hence we find in certain kinds of iron—pig iron from the blast furnaces smelted under conditions favourable to the formation of graphite—that the separation takes places as it runs from the furnace, a true separation by solidification. I think I mentioned to you on a former occasion that, as carbon in the form of graphite so separates from iron, silicon may also separate from iron in exactly the same way. We can form graphite, then, without difficulty, and it is the result of a very high temperature.

In nature, graphite occurs in granite, gneiss, mica-slate, and also in crystalline limestone; it occurs in greenstone and in nests. At Borrowdale, in Cumberland, it is met with in trap rock. There you have an igneous action. It occurs in Davis' Straits and in Russia, and also in many other places. Now, how far the information we possess concerning the artificial production of graphite will apply to the solution of that question which relates to its formation in nature, I am not prepared to state. I do not think there is any evidence for supposing that in nature we have had this element, iron, at work. There must be some other condition under which graphite has been formed in nature, and at present further experiments are required to

enable us to settle this point satisfactorily. I think there is no doubt, however, that a high temperature has in every case been concerned.

The subject I have next to bring before you is that of iron, and a great subject truly it is. I have already spoken of iron pyrites, and I need not repeat what I said concerning it.

Iron is one of the most abundantly diffused elements; it exists everywhere—not only in this world, but apparently throughout the universe. It is detected even in the atmosphere of the sun.

Probably the most remarkable state of iron is the meteoric, in which it occurs in those bodies called meteorites—small stars, or planets, or asteroids, which frequently fall to the earth when they come within the sphere of its attraction. These bodies, or some of them at all events, consist almost wholly of iron, but never, so far as I know, of pure iron. They are associated with other metallic bodies, especially nickel and cobalt, and we find some of these meteoric irons including also various other compounds. There is a particular quality of iron pyrites, for example, and a great many other things have been found in them. One of the most remarkable is that which I called your attention to on a former occasion—chrysolite, of which I showed you a specimen. Here is a cellular mass of meteoric iron, the cells of which are filled in with this chrysolite or silicate of magnesia. To enter into the details of this meteoric iron would occupy a whole lecture, so I can only deal with mere generalities. All this meteoric iron, or, if not all, the greater part of it, presents a singular appearance when treated by acids under certain conditions. If you take the best of it that occurs, and polish it, and etch the surface by means of nitric acid, certain figures known as the Widmanstätian figures will come out. These figures are different in structure, and it is remarkable how they should occur upon a mass consisting of the same crystals. Why should one part be attacked more than another? Different faces of the same crystal are acted upon in different degrees by the same acid. There is a peculiarity about these figures which was mentioned to me by Professor Widmanstät, of Berlin. He says the same faces of the crystals are acted upon with different intensities by hydrochloric acid, and different parts are acted upon with different degrees of intensity, even in the same crystal. That is a fact which easily explains how we get these figures when acting upon the surface of a piece of polished meteoric iron by an acid. I am indebted to my friend Mr. Tennant for some of the specimens of meteoric iron now on the table. A very large meteorite—I suppose one of the largest in the world—has recently arrived from Australia in this country, and is now in the British Museum. The structure of some of these meteorites is excessively interesting, but, as I hinted, time forbids my doing justice to this part of our subject. There are some points in connexion with these meteorites interesting to us in a geological point of view—namely, the presence of nickel and cobalt, nickel especially. The association of these three metals in nature—iron, nickel, and cobalt—is worthy of our serious attention. It has not received so much attention hitherto as I think it deserves. The fact is, it is only recently—within the last few years, comparatively, at all events—that very careful attention has been attracted to the subject of the composition of different kinds of iron. We have found, from the analysis of iron produced in different localities in this country, decided indications of both nickel and cobalt in almost every case when we have sought for them. I mention this particularly in order to excite further inquiry. It is really a point deserving of serious and continuous observation. It seems to indicate a connexion between these three metals much more general than one has supposed. We find a singular connexion between lead and silver, or lead, silver, and gold; and it would appear from this meteoric iron, and also from specimens of iron from different localities, that a similar relation exists between the three metals iron, nickel, and cobalt.

What the source of these meteorites is, is, of course, entirely unknown at present. Various conjectures have been put forth, such as the consolidation, the result of the aggregation of cosmical dust. Cosmical dust is supposed to be floating everywhere throughout the universe. This is rather an old notion. Berzelius very properly inquired, if this cosmical dust, by its aggregation, can produce these meteorites, how is it that we do not find them on the tops of our highest mountains? With regard to these meteorites I may add that they seem to have fallen at different times on the earth in different parts of the world, and sometimes in great abundance, and I think we ought to find more extensive remains of them than we have hitherto found in ancient geological formations, if, indeed, we have found any. A short time ago a paper was published in *Poggendorff's Annalen* giving an account of the remains of a meteorite being found deep in the sandstone at Oldenburg.

Of the pure chemistry of iron it does not become me to say anything on the present occasion. I must give you credit for knowledge on that topic.

It has been supposed that metallic iron occurs native not only in meteoric stones or meteoric masses, but in certain trap rocks. Experiments were made a great many years ago by Professor Andrews, of Belfast, upon certain trap rocks which, he says, when immersed in a solution of copper, caused the deposition of metallic copper, and he thence inferred that these rocks contained metallic iron diffused throughout. But I do not think the evidence is quite conclusive, or sufficient to justify that conclusion. I think there is another way of accounting for that deposition, short of supposing the presence of metallic iron.

(To be continued.)

BRITISH ASSOCIATION, NOTTINGHAM MEETING.

Friday, August 24.

A Lecture "On the Results of Spectrum Analysis, as applied to the Heavenly Bodies," by William Huggins, *F.R.S.*

(*Concluded from page* 210.)

The most remarkable, and possibly the nearest to our system, of the nebulæ presenting a ring formation, is the well-known annular nebula in Lyra. The spectrum consists of one bright line only. When the slit of the instrument crosses the nebula, the line consists of two brighter portions corresponding to the sections of the ring. A much fainter line joins them, which shows that the faint central portion of the nebula has a similar constitution.

A nebula remarkable for its large extent and peculiar form, is that known as the dumb-bell nebula. The spectrum of this nebula consists of one line only. A prismatic examination of the light from different parts of this object, showed that it is throughout of a similar constitution.

The most widely known, perhaps, of all the nebulæ is that remarkable cloud-like object in the sword-handle of Orion.

This object is also gaseous. Its spectrum consists of three bright lines. Lord Rosse informs me that the bluish-green matter of the nebula has not been resolved by his telescope. In some parts, however, he sees a large number of very minute red stars, which, though apparently connected with the irresolvable matter of the nebula, are yet doubtless distinct from it. These stars would be too faint to furnish a visible spectrum.

I now pass to some examples of the other great group of nebulæ and clusters.

All the true clusters, which are resolved by the telescope into distinct bright points, give a spectrum which does not consist of separate bright lines, but is apparently continuous in its light. There are many nebulæ which furnish a similar spectrum.

I take as an example of these nebulæ the great nebula in Andromeda, which is visible to the naked eye, and is not seldom mistaken for a comet. The spectrum of this nebula, though apparently continuous, has some suggestive peculiarities. The whole of the red and part of the orange are wanting. Besides this character, the brighter parts of the spectrum have a very unequal and mottled appearance.

It is remarkable that the easily resolved cluster in Hercules has a spectrum precisely similar. The prismatic connexion of this cluster with the nebula in Andromeda is confirmed by telescopic observation. Lord Rosse has discovered in this cluster dark streaks or lines similar to those which are seen in the nebula in Andromeda.

In connexion with these observations, it was of great interest to ascertain whether this broad classification afforded by the prism of the nebula and clusters would correspond with the indications of resolvability furnished by the telescope. Would it be found that all the unresolved nebulæ are gaseous, and that those which give a continuous spectrum are clusters of stars?

Lord Oxmantown has examined all the observations of the 60 nebulæ and clusters in my list, which have been made with the great reflecting telescope erected by his father, the Earl of Rosse.

The reaults are given in this table:—

	Continuous Spectrum.	Gaseous Spectrum.
Clusters	10	0
Resolved, or Resolved?	5	0
Resolvable, or Resolvable?	10	6
Blue or Green, no resolvability, no resolvability seen	0 6	4 5
	31	15
Not observed by Lord Rosse	10	4
	41	19

Considering the great difficulty of successful telescopic observation of these objects, the correspondence between the results of prismatic and telescopic observation may be regarded as close and suggestive.

Half of the nebulæ which give a continuous spectrum have been resolved, and about one-third more are probably resolvable; while of the gaseous nebulæ none have been certainly resolved, according to Lord Rosse.

The inquiry now presses itself upon us—What superstructure of interpretation have we a right to raise upon the new facts with which the prism has furnished us?

Is the existence of the gaseous nebulæ an evidence of the reality of that primordial nebulous matter required by the theories of Sir William Herschel and Laplace?

Again, if we do not accept the view that these nebulæ are composed of portions of the original elementary matter out of which suns and planets have been elaborated, what is the cosmical rank and relation which we ought to assign to them? As aids to a future determination of these great questions, I will refer in a few words to some other observations.

COMETS.

There are objects in the heavens which occasionally, and under some conditions, resemble closely some of the nebulæ. In certain positions in their orbits, some of the comets appear as round vaporous masses, and, except by their motion, cannot be distinguished from nebulæ. Does this occasional general resemblance indicate a similarity of nature? If such be the case—if the material of the comets is similar to that of the nebulæ, then the study of the wonderful changes which comets undergo in the neighbourhood of the sun may furnish useful information for a more correct interpretation of the structure and condition of the nebulæ. In 1864, Donati found that the spectrum of a comet visible in that year consisted of bright lines.

Last January a small telescopic comet was visible. It was a nearly circular, very faint vaporous mass. Nearly in the centre, a small and rather dim nucleus was seen. When this object was viewed in the spectroscope, two spectra were distinguished. A very faint continuous spectrum of the coma, showing that it was visible by reflecting solar light, and about the middle of this faint spectrum a bright point was seen. This bright point is the spectrum of the nucleus, and shows that its light is different from that of the coma. This short bright line indicates that the nucleus of this comet was self-luminous; and, further, the position of this line of the spectrum suggests that the material of the comet was similar to the matter of which the gaseous nebulæ consist.

MEASURES OF THE INTRINSIC BRIGHTNESS OF THE NEBULÆ.

It appeared to me that some information of the nature of the nebulæ might be obtained from observations of another order. If physical changes of the magnitude necessary for the conversion of these gaseous bodies into suns are now in progress in the nebulæ, surely this process of development would be accompanied by marked changes in the intrinsic brightness of their light, and in their size.

Now, since the spectroscope shows these bodies to be continuous masses of gas, it is possible to obtain an approximate measure of their real brightness. It is known that as long as a distant object remains of sensible size, its brightness remains unaltered. By a new photometric method I found the intrinsic intensity of the light of three of the gaseous nebulæ in terms of a sperm candle burning at the rate of 158 grains per hour.

Nebula, No. 4628, $\frac{1}{1300}$th part of the intensity of the candle.
Annular Nebula in Lyra . $\frac{1}{6000}$nd " " " "
Dumb-bell Nebula $\frac{1}{18000}$th " " " "

These numbers represent not the apparent brightness only, but the true brightness of these luminous masses, except so far as it may have been diminished by a possible power of extinction existing in cosmical space, and by the absorption of our atmosphere. It is obvious that similar observations made at considerable intervals of time may show whether the light of these objects is undergoing increase or diminution, or is subject to a periodic variation. If the dumb-bell nebula, the feeble light of which is not more than one twenty-thousandth part of that of a candle, be in accordance with popular theory a sun-germ, then it is scarcely possible to put in an intelligible form the enormous number of times by which its light must increase before this faint nebula, feebler now in its glimmering than a rushlight, can rival the dazzling splendour of our sun.

MEASURES OF THE NEBULÆ.

Some of the nebulæ are sufficiently defined in outline to admit of accurate measurement. By means of a series of micrometric observations, it will be possible to ascertain whether any considerable alteration in size takes place in nebulæ.

Mr. Alexander Herschel has recently succeeded in subjecting another order of the heavenly bodies to prismatic analysis. He has obtained the spectrum of a bright meteor, and also the spectra of some of the trains which meteors leave behind them. A remarkable result of his observations appears to be that sodium, in the state of luminous vapour, is present in the trains of most meteors.

CONCLUSION.

In conclusion, the new knowledge that has been gained from these observations with the prism may be summed up as follows:—

1. All the brighter stars, at least, have a structure analogous to that of the sun.

2. The stars contain material elements common to the sun and earth.

3. The colours of the stars have their origin in the chemical constitution of the atmospheres which surround them.

4. The changes in brightness of some of the variable stars are attended with changes in the lines of absorption of their spectra.

5. The phenomena of the star in Corona appear to show that in this object at least great physical changes are in operation.

6. There exist in the heavens true nebulæ. These objects consist of luminous gas.

7. The material of comets is very similar to the matter of the gaseous nebulæ, and may be identical with it.

8. The bright points of the star clusters may not be in all cases stars of the same order as the separate bright stars.

It may be asked what cosmical theory of the origin and relations of the heavenly bodies do these new facts suggest? It would be easy to speculate, but it appears to me that it would not be philosophical to dogmatise at present on a subject of which we know so very little. Our views of the universe are undergoing important changes. Let us wait for more facts, with minds unfettered by any dogmatic theory, and therefore free to receive the obvious teaching, whatever it may be, of new observations.

ACADEMY OF SCIENCES.

November 5.

The approach of the busy season is shown by the numerous communications which are now being sent in to the Academy from all parts of the kingdom. The first communication was from Maréchal Vaillant, who announced the discovery of an aerolite weighing 780 kilogrammes, found in Mexico. This, like everything else, is to appear in the Exhibition next year. The conclusion of the paper "*On the Functions of Leaves*," by M. Boussingault, was then read. The results obtained by the author are confirmatory of those we gave last week. He finds the thickness of the leaf and its consequent transparency to light influence the results in a marked degree.

"*On the Principal Causes of the Rapid Passage of Rain Water into Rivers and their Feeders during Floods*," by M. Becquerel.

"*On the New Planet* (91)," by M. Leverrier.

"*On the Blue Coloration of Glasses and Slags*," by M. J. Fournet. The author, who has had this subject under notice for upwards of five and twenty years, has come to the conclusion that the blue coloration of slags, as well as of bottle glass, is the pure and simple result of molecular grouping, of which opacity—that is to say, white enamel—is the final product. By polishing pieces of this blue glass, varying in thickness, a decided dichroism is observed—blue by reflection, and orange by transparency. Generalising the result of these observations, the author shows that this dichroism belongs to many substances met with in nature; corundum, phosphate of iron, pure water, and clouds, all show it under certain circumstances.

"*On a Method of realising Pneumatic Occlusion on the Surface of the Human Body*," by M. J. Guérin.

"*A New Electric Generator or Continuous Electrophorus*," by M. Bertach. This is an improvement on the somewhat celebrated electric machine of Holtz. The machine is too complicated to allow of description in abstract. With a disc of vulcanite 50 centimetres diameter, sparks of about 15 centimetres long can be obtained at the rate of from five to ten a second, and having sufficient tension to pierce a glass one centimetre thick, and to illuminate continuously a tube of rarefied gas one metre long. In thirty or forty seconds it will charge a battery having an interior surface of two square metres, which will burn up a thick iron wire one metre in length.

"*On the Action of Heat on Benzol and analogous Hydrocarbons*," by M. Berthelot. When passed through a red-hot porcelain tube, benzol decomposes with condensation into several definite hydrocarbons, the principal being phenyl $C_{24}H_{10}$. This is identical with the phenyl which Fittig obtained by the action of sodium on bromo-benzol; it fuses at 70°, boils at 250°, and crystallises very definitely. Another product, obtained in smaller quantity, is chrysen $C_{36}H_{12}$, and after this a solid resinous hydrocarbon is produced, but naphthalin and anthracen. When toluol is passed through a red-hot tube, it furnishes a considerable quantity of benzol, naphthalin, a small quantity of a crystallised carbide boiling at 270°, anthracen $C_{28}H_{10}$, and several other hydrocarbons analogous to chrysen and the last derivatives of benzol. When a mixture of benzol and ethylene is passed through a red-hot tube, there are formed—styrol, $C_{16}H_8$; naphthalin, $C_{20}H_8$, the principal product; a crystallised hydrocarbon, boiling at 260°, analogous to phenyl, but distinguished from it by the formation of a characteristic compound of picric acid and anthracen. As a *résumé* of all his experiments, the author gives the following formulæ as expressing the parentage and generation of the pyrogenous hydrocarbons from benzol and acetylene:—

Benzol . . .	$C_4H_2[C_4H_2(C_4H_2)]$
Styrol . . .	$C_{12}H_4[C_4H_2(H_2)]$
Naphthalin . .	$C_{12}H_4[C_4H_2(C_4H_2)]$
Phenyl . . .	$C_{12}H_4[C_{12}H_4(H_2)]$
Anthracen . .	$C_{12}H_4[C_{12}H_4(C_4H_2)]$
Chrysen . . .	$C_{12}H_4[C_{12}H_4(C_{12}H_4)]$

"*On Blue Slags*," by M. Mène. The author concludes that the blue colour is due to a mixture of proto- and peroxide of iron.

"*On some New Notions respecting the Action of Acids on Saccharine Juice*," by M. Kessler-Desvignes.

"*On the Poisonous Properties of Boundon, the Ordeal Poison of the Gabonese*," by MM. Pécholier and Saint-pierre.

NOTICES OF BOOKS.

Lecture Notes for Chemical Subjects: embracing Mineral and Organic Chemistry. By E. Frankland, F.R.S. London: J. Van Voorst. 1866.

We welcome the appearance of this most interesting book with real pleasure. At first sight, indeed, the dashes, the thick letters, the strange formulæ, and the multitudes of curious diagrams, reminding us of the Greek trees of our early days, gave us the idea of a new science, which would surely prove hard to master. But Dr. Frankland has demonstrated, in the opening chapters of this volume, that he can write with equal success for the young student and for the advanced chemist. The lingering fondness of the old school for the half truths and downright errors of most of our text-books, must give way before the clearness, the accuracy, and, we will say also, the simplicity of the views unfolded in the pages now under review.

This volume of lecture notes is not a manual of chemistry in the ordinary sense of the words. It says but little of the manufacture of chemical compounds; it scarcely alludes to their outward and sensible properties, but it gives many instructive glimpses of their interior constitution. It offers, as it were, a sketch of the structure and leading features of the chemical edifice, leaving us to add afterwards, from other sources, the minuter details. Yet, notwithstanding the breadth of view which thus characterises the work, there is no lack of precision. It is evident that no pains have been spared to secure and use the most accurate data, and to look upon doubtful questions from all sides. We do not, however, mean to affirm that the book is, in our opinion, faultless; in fact, the author himself states in his preface that he is "aware

that the atomicity which is assigned to many of the elements may be called in question." But we may safely say that the author's thorough scheme of the combining powers of the atoms, and his methods and examples of symbolic and graphic expression, will prove a great boon to the student of chemistry, and will aid materially in furthering the development of the science.

In the quotation made in the preceding paragraph from the author's preface, we meet with one of the very few features in his book which we deem open to criticism. We refer to what we cannot but think, with due deference be it said, the confused and confusing use of the words *atomic* and *atomicity*. Dr. Hofmann, in his "Introduction to Modern Chemistry," page 168, has so clearly pointed out the illogical employment of the term atomic to signify two totally distinct facts, that we prefer to use his language, and to cite his authority in speaking of this subject. He says:—"We are in want of a good appellation to denote the atom-fixing power of the elements. The vague and rather barbarous expression, atomicity, has drifted into use for this purpose, and the elements have been called *mon*atomic, *di*atomic, *tri*atomic, and *tetr*atomic, accordingly as their respective molecule-forming minimum weights are capable of saturating one, two, three, or four standard atoms. These expressions are faulty, because they are open to misinterpretation, as if intended to denote the atomic structure of the respective elementary molecules themselves—a sort of confusion, the possibility of which should always be sedulously avoided in scientific nomenclature. We shall escape this evil by substituting the expression *quantivalence* for *atomicity*, and designating the elements *uni*valent, *bi*valent, *tri*valent, and *quadri*valent, according to their respective atom-fixing values." We need add nothing to these remarks save to point out that Dr. Frankland uses the word atomic in two senses. It is used, accompanied by a prefix, to indicate, in the case of a molecule, the number of atoms in that molecule; when applied to an atom, it shows the number of "bonds" in that atom, each bond being satisfied by, or capable of attaching, one atom of hydrogen. We are bound to confess, however, that our author is careful to use the words monad, dyad, triad, &c., in lieu of monatomic, diatomic, triatomic, &c., when atoms of elements are referred to, and thus these latter special terms are confined to their proper use, although two meanings are attached to the general expressions *atomic* and *atomicity*.

We may now proceed to point out some of the special characteristics which distinguish these Lecture Notes for Students from the ordinary handbooks of chemistry. The formulæ first demand attention.

We find the *bracket* used for one purpose only—namely, to indicate chemical union between elements placed perpendicularly to each other, and next the bracket in a formula; thus—

1. $\left\{\begin{matrix}CH_3\\CH_2Cl\end{matrix}\right.$ 2. $\left\{\begin{matrix}CH_3\\O\\CH_3\end{matrix}\right.$ 3. $\left\{\begin{matrix}COO\\Ba\\COO\end{matrix}\right.$

In formula 1, the bracket shows that the two atoms of carbon are directly united with each other; in formula 2, that the two atoms of carbon are linked to each other by the atom of oxygen; whilst in formula 3, we perceive that one atom of oxygen in the upper line is united to an atom of oxygen in the lowest line by the mediation of the atom of barium.

The use of thick letters in formulæ is another characteristic of importance. These are used to indicate the central or chief element of a compound. In the symbolic formulæ, this element is generally placed first, and to it all the active bonds of the other elements or compound radicals following on the same line are supposed to be linked. Thus the formula for microcosmic salt becomes

POHoAmoNao.

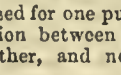
Here the pentad element phosphorus is combined with the dyad element oxygen, and the three monad radicals which follow. (We should mention that Ho = HO or hydroxyl, and that in the other radicals also o has the same value as O.) Other examples of the use of thick letters follow:—

Sulphuric acid . . .	SO_2HO_2
Water	OH_2
Nitric acid	NO_2Ho
Ferrous sulphate . . .	$SOHo_2Feo''$
Phosphoric iodide . .	PH_4I.

The marks of atomicity (or, as we should prefer to say, "quantivalence") are employed for the most part in the usual manner by Dr. Frankland; but in some instances their position with regard to the symbol is varied. Thus, when the pentad element nitrogen becomes a triad, as in ammonia, and a monad, as in nitrous oxide, the symbols will undergo the following modifications:—

$N'_2O''_5$ Nitric anhydride.
$''N'''H_3$ Ammonia.
$''N'_2O$ Nitrous oxide.

In the first formula the pentad character of the element is preserved; in the second, a pair of bonds, indicated by the two dashes to the left of the symbols, have united or saturated each other; and in the third formula two pairs of bonds have been thus affected. This kind of union is also called *latent atomicity*, the absolute atomicity being the maximum number of bonds of an element. We think, with Dr. Hofmann, that a slight increase of clearness in these marks of atomicity would be obtained by the consistent use of Roman numerals instead of dashes and numerals; or, perhaps better still, of ordinary dashes for the lower values and of crossed dashes for the higher. And we would further suggest that, as proposed in this journal some years ago, the basylous or chlorous character of the constituents of a body may often be advantageously indicated by the *inclination* of the marks of quantivalence. The ordinary marks of basylous quantivalence may slant, as usual, to the left, those of chlorous quantivalence to the right, and those which indicate suppressed or self-saturated bonds may be represented by vertical dashes. In pyrites, for instance, the basylous quantivalence of the Fe is shown by two left-handed dashes; the chlorous quantivalence of the S_2 by one right-handed dash, and the neutral quantivalence of these sulphur atoms by one vertical dash, this last sign indicating that one bond of one sulphur atom saturates one bond of the other sulphur atom. The same fact is expressed graphically thus:—



Little Experiments for Little Chemists. By William Henry Walenn, F.C.S. London: T. J. Allman.

This little book is intended for the junior classes at schools where chemistry is taught, or as a recreation for the young student in his holidays. Great attention is paid to enforcing the necessity of cleanliness in all chemical manipulations, and care is taken to limit the apparatus required to the simplest articles, while strong acids and poisons are, where possible, avoided. The subjects treated of are:—The action of chemical solutions upon each other; the phenomena of crystallisation; and the precipitation of metals from their solutions. The experiments are arranged in series, each of which is headed by a list of the articles required, and concludes with a paragraph entitled "Results or Uses," which shows the applications of the phenomena just produced. The experiments are selected so as to be of a striking character, and we can recommend this work as one calculated to amuse, while it instructs, the young chemist.

CONTEMPORARY SCIENTIFIC PRESS.

[Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted.]

Dingler's Polytechnisches Journal. No. 4. August.

"*On the Detection of the Presence of Air in Carbonic Acid and other Gases,*" by Graeger.

"*On the Commercial Preparation of Azaleine, Rubine, or Mercury-Fuchsine,*" by T. Oppler. (Extract from *Theorie und praktische Anwendung von Anilin, &c.*")

"*On the Composition of certain Sugars, and of some Products obtained during their Manufacture,*" by J. L. Kleinschmidt.

"*On Tanning;*" 2. "*On Tanning Kid Leather,*" by F. Knapp.

"*On the Behaviour of Copper and Silver in Solutions of Arsenious, Sulphurous, Selenious, and Phosphorous Acids,*" by H. Reinsch.

"*On the Manufacture of Caramel for Colouring Spirit,*" by E. Assmuss.

"*On the Preparation of Coloured Inks with Aniline,*" by J. Fuchs.

No. 5. September.

"*On the Recovery of Peroxide of Manganese from the Chloride of Manganese formed during the Manufacture of Chlorine,*" by P. W. Hopmann.

"*On the Manufacture of Borax,*" by G. Lunge.

"*On Testing Mineral Oils,*" by J. Salleron and V. Urbain.

"*On the Preparation of Commercial Formic Ether,*" by J. Stinde.

"*On Obtaining Uric Acid from Peruvian Guano,*" by J. Lowe.

"*On the Quantity of Juice contained in Beetroot,*" by C. Stammer.

"*On a New Explosive Compound,*" by C. Lesimple.

"*On the Presence of Sulphates in Filter Paper,*" by Kruger.

"*On the Preparation of Peroxide of Barium and Peroxide of Hydrogen.*"

"*On Bleaching Palm Oil,*" by A. Engelhardt.

"*On the Organic Constituents of Beet Juice,*" by C. Scheibler.

Annales de Chimie et de Physique. September.

"*Researches on Silicic Ethers and on the Atomic Weight of Silicium,*" by C. Friedel and J. M. Crafts.—"*On the Cultivation of Tobacco in Alsace,*" by J. B. Boussingault.—"*On the Cultivation of Tobacco in the Department of the Bas Rhin,*" by E. Oppermann.—"*Experiments on Churning, followed by an Analytical Investigation of the Influence of the Food of the Cow on the Quantity of Butter contained in Milk,*" by J. B. Boussingault.

October.

"*Notes on the History of the Phosphorus Compounds of Zinc,*" by B. Renault.—"*Memoir on Supersaturation,*" by Lecoq de Boisbaudran.

NOTICES OF PATENTS.

No. 525. *Improved Dye.* James Barry, Ballyclough, in the County of Cork, J. P. Dated February 20, 1866.

This invention has reference to an improved dye prepared from the lichen grown parasitically upon apple or crab trees.

To extract the colouring matter from the lichen and employ it for the purposes of dyeing, the patentee causes the lichen in its raw or unprepared state (procured from the apple or crab trees aforesaid) to be first cleansed from foreign matters, dried, reduced to powder, and subsequently macerated as may be found desirable. The lichen thus treated is then placed within closed vessels charged with water, proportionately to the concentration or varied shades of colour required. It is then submitted to the operation of boiling, until the colouring extract or matter is produced, which when strained, or chemically treated, and the whole of the insoluble matters removed, is rendered clear and fit for use. By this process any or all of the various descriptions of earths, alkalies, acids, salts, metallic oxides, or other reagents which may be found necessary for combining with and improving the body or colour of the dye, may be employed, either separately or in conjunction with suitable mordants for fixing the said dye and rendering the same permanent. In conclusion to the foregoing description, the patentee briefly notes that the process of applying or imparting the colouring matter to the various articles to be dyed, either in union with mordants or otherwise, may be varied as may be found necessary; thus the simple solution, independently of other chemical matters, may be applied directly to the cloth by steeping, or otherwise saturating the same through the medium of suitable apparatus or machinery as at present, admitting at the same time of the surface being dyed, woven, or ornamented, as may be found desirable.

No. 540. *Refrigerating or Freezing Liquids.* (Provisional protection). B. W. Richardson, Doctor of Medicine. Dated February 21, 1866.

This invention relates to certain improvements in the means of refrigerating or freezing liquids, and for producing ice, and also in apparatus to be employed therein.

The agents which the patentee proposes to use are ethers or volatile hydrocarbons, or other volatile fluids of low boiling point which produce intense cold when volatilised or distributed in the form of spray or dew in a pulverised state. He also proposes to use the hydrocarbon products from gas works which boil at a low temperature.

The liquid to be refrigerated is contained in a metallic vessel in the form of an inverted cone. This vessel contains a false perforated small cone attached to a rod or handle, or to two rods, in order that it may be lifted out or removed from the exterior cone, and withdraw the frozen particles of the liquid.

The conical receptacle is contained in a cylinder or outer casing, at the bottom of which is a reservoir for containing the volatile fluid, which is withdrawn therefrom and pumped through a series of tubes or apertures on and around the circumference of the conical chamber. The pump to be used consists of an india-rubber hand bellows or pump actuated by compression, or by bellows, or cylinder and piston pump, and controlled by suitable valves for inlet and exit of the volatile fluid, which is thereby impelled in the form of dew or spray (or as if it were pulverised) upon the surface of the cone, thereby creating an intense degree of cold. According to this invention, therefore, the cold is produced by the contact of pulverised spray of volatile fluid, which becomes condensed and falls into a receiver underneath the cone wherein it is collected, and may be withdrawn for further use over and over again.

The apparatus may be made of any size, but the chief object of the invention is to supply a portable apparatus for the purpose of refrigerating or freezing small quantities of liquid. The patentee prefers to use a conical vessel, since by such a form he can freeze liquid most rapidly.

For refrigerating wine he employs a cylinder of either metal or earthenware, in which the bottle is placed, and the volatile fluid is impelled thereon by the process before described. Similar methods of collecting the volatile fluid for further application may be adopted.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, F.C.S., Patent Agent, 54, Chancery Lane, W. C.

2454. J. Gamgee, Bayswater, Middlesex, and A. Gamgee, M.D., "Improvements in the slaughtering of animals with a view to the preservation of their bodies as articles of food, and in the method of preserving animal and vegetable substances."—Petition recorded Sept. 24, 1866.

2733. J. Greenshields, Glasgow, N.B., "Improvements in making gas and coke."—October 23, 1866.

2745. H. D. Plimsoll, Great Ormond Street, Middlesex, J. B. Davies, Gresham Street, London, and W. R. Dawson, Homerton, Middlesex, "Improvements in extracting metals from titaniferous iron, sand, or minerals containing metals."

2749. J. C. Stevenson, South Shields, "Improvements in furnaces for the manufacture of alkali."—Oct. 24, 1866.

2755. C. E. Brooman, Fleet Street, "Improvements in apparatus for lighting and heating." A communication from J. B. M. A. Bourreiff, Paris.—October 25, 1866.

2773. J. Wagener, Wellclose Square, and G. J. Firmin, Millwall, "Improvements in sugar refining."—October 26, 1866.

Notices to Proceed.

1703. W. R. Lake, Southampton Buildings, Chancery Lane, "Improvements in the manufacture of white lead." A communication from W. Bell, T. M. Fell, and A. G. Fell, New York, U.S.A.—Petition recorded June 26, 1866.

1726. C. E. Brooman, Fleet Street, "Improvements in obtaining alkaline permanganates." A communication from C. M. T. du Motay, and C. R. Marechal, Metz, France.—June 28, 1866.

CORRESPONDENCE.

The Smoke Question.

To the Editor of the Chemical News.

Sir,—Your correspondent, "W. S.," merits respectful treatment from the evidence his letter affords of the careful perusal he has given my paper published in your last number. I must also allow that there is some justice in several of his criticisms.

1st. My statement that nitrogen is poisonous to animal life is probably not a happy expression. That pure nitrogen gas would be destructive of animal life surrounded by it only, "W. S." will not deny, and this should have been the form in which it should have been presented.

2nd. That fresh charcoal is newly precipitated carbon is, I think, substantially true; in ligneous fibre carbon only exists in combination, and when the other elements are eliminated, and the carbon left, it is at least a change analogous to precipitation.

3rd. The amount of carbonic acid gas. 146,666 tons was correctly stated in the first copy of my paper, but in transcribing it the calculation was again hastily gone over, taking 50,000 tons as the basis, and not 80 per cent of this, as should have been done.

4th. In the last criticism of "W. S." we differ only by looking at different objects. As my paper chiefly dealt with combustion, perfect and imperfect, my statement as to our practically getting not more than half the available heat went only so far as the evaporation of water. Perfect combustion of average Lancashire coal, and perfect application of the heat evolved to the evaporation of water, would give 13 lbs. water converted into steam for 1 lb. of coal used, while our practice gives only 5 to 7 lbs.

The obtaining of the theoretical heat-power or force was not in any sense in my mind.

Thanking your correspondent for the courteous tone of his remarks, I am, &c. Peter Spence.

Manchester, November 12.

Process for the Estimation of Resin in Soaps.

To the Editor of the Chemical News.

Sir,—As one who has had more than a mere book knowledge of the reaction of nitric acid on oleic and margaric acids, I would respectfully remind Mr. Sutherland that a "distinctly appreciable quantity of nitrous acid is given off" during the reaction, and that, when we use "strong nitric acid," there is even a copious evolution of nitrous fumes, and also that these fumes are evolved until the reaction I have alluded to is completed; so that Mr. Sutherland, I am sure, will grant that, in the absence of his subsequent explanation, I was justified in taking objection to the process.

From the facts that Mr. Sutherland has adduced, there is no doubt but that he has obtained good results; and as the process seems to be an important one, perhaps he would favour us with the strength of the nitric acid he employed when he obtained his best estimations.

Apologising for again trespassing on your space,

I am, &c. S. H. J.

Wolverhampton.

MISCELLANEOUS.

Composition and Quality of the Metropolitan Waters in October, 1866.—The following are the Returns of the Metropolitan Association of Medical Officers of Health:—

Names of Water Companies.	Total solid matter per gallon.	Loss by ignition.*	Oxidisable organic matter.†	Hardness.	
				Before boiling.	After boiling.
Thames Water Companies.	Grains.	Grns.	Grains.	Degs.	Degs.
Grand Junction . . .	21·00	1·00	0·81	15·0	5·0
West Middlesex . . .	20·98	1·01	0·98	16·0	6·5
Southwark & Vauxhall .	21·66	1·14	1·00	15·0	6·0
Chelsea.	20·33	0·66	0·59	14·0	6·0
Lambeth	21·34	0·75	0·80	16·0	5·0
Other Companies.					
Kent	27·19	1·98	0·28	18·5	8·0
New River	18·87	0·75	0·31	15·0	4·5
East London . . .	18·59	0·80	0·68	16·0	5·0

* The loss by ignition represents a variety of volatile matters, as well as organic matter, as ammoniacal salts, moisture, and the volatile constituents of nitrates and nitrites.

† The oxidisable organic matter is determined by a standard solution of permanganate of potash, the available oxygen of which is to the organic matter as 1 : 8; and the results are controlled by the examination of the colour of the water when seen through a glass tube two feet in length and two inches in diameter.

H. Letheby.

ANSWERS TO CORRESPONDENTS.

Dr. Rossler's request shall be attended to.

M. O. P.—The salt is acetate of lime.

A. C. S.—Commercial carbonate of bismuth frequently contains basic nitrate. This will explain the effect noticed.

M. L. B.—Moisten the portion of the linen which has the fruit stain on it, and then expose it to the fumes of burning sulphur. This will generally be found effectual.

T. Williams asks if there is a translation from German to English of Professor Will's table of qualitative chemical analysis. Can any correspondent favour us with the information?

Dialysis, F. A.—This beautiful discovery has been utilised by Mr. Whitelaw, of Glasgow, for separating the salt from meat brine. We do not, however, know whether the process is now in operation anywhere.

Blowpipeist.—The cause of the green colour communicated to the flame by the iron wire is the presence of a minute trace of phosphorus in the metal. See Mr. Chapman's letter in the Chemical News, vol. ix., p. 180.

Fitzetienne.—We do not know any text-book of natural philosophy that treats its subjects so fully in respect to the conservation of energy as you require. Tyndall's "Heat as a Mode of Motion" will doubtless satisfy your requirements as far as that science is concerned, and there are several other works on special branches of science, recently reviewed in our columns, which you might consult with advantage.

Dr. Roscoe, E. J. Chapman, W. Chisholm, T. Clarke, W. L. R., S. R.—Received, but deferred till next week owing to press of matter.

Books Received.—"On Pulmonary Consumption," by Dr. Henry Bennet, M.D., &c.

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(Copy.)

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Iodine	Traces
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THE

CHEMICAL NEWS

AND

Journal of Physical Science.

Edited by] [*Wm. Crookes, F.R.S.*

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

New Researches on the Law of Chemical Proportions, and on Atomic Weights and their Mutual Relations, by J. S. Stas.*

(Concluded from page 230.)

Such is the abridged indication of the new researches which I have undertaken or completed in the last five years, in order to assure myself by experiment whether or not a simple relation exists between the weights of the bodies which unite to form chemical combinations.

With a view of satisfying the wish expressed by most of the chemists who have had occasion to examine my means of investigation, I have added to each of these memoirs figures, designed to render the operations and apparatus there described more easily intelligible. I have also explained my researches with a fulness which I hope will be found sufficient.

I do not disguise that the compilation of these memoirs leaves much to be desired with respect to unity. I even confess that it might be singularly simplified. The imperfections presented by these works proceed from this—that they have been written at very different periods, and that I have only had in view the facts related in each of them, without being preoccupied with what goes before or may follow; but on attentive consideration I thought that in their revision I ought to pass over these defects, because they strictly express the facts observed, and the conclusions which result separately from each of them.

It now remains for me to recapitulate and conclude. I have sought to discover whether the law of chemical proportions is an absolutely exact one; I think I have proved that it is the expression of a mathematical relation. I believe I have also demonstrated that the atomic weight of a like body, determined by the aid of different elements and of independent methods—a weight which *ought* to be identical—is in *reality* so, within the limits of accuracy at which it is possible to arrive by our present means of investigation.

The values of the atomic weights which proceed from all these researches are the following:—

Oxygen being taken by hypothesis . =	16·000
Silver is	107·930
Nitrogen	14·044
Bromine	79·952
Chlorine	35·457
Iodine	126·850
Lithium	7·022
Potassium	39·137
Sodium	23·043

These atomic weights are necessarily *means;* but as the values result from determinations which have, for the most part, undergone numerous controls, obtained by the aid of independent methods, I think that the first and very probably the second decimal of nearly, if not quite, all these atomic weights, may be considered as certain.

When we wish to confine ourselves to a *unit*, with which experience may correspond, it is easy to prove that no simple relation exists between these different atomic weights. I have expressly said that all these values are determined by reference to oxygen, taken *hypothetically* equal to 16. If referred to hydrogen taken as the unit, they must necessarily be corrected, from the fact of the difference which exists between the atomic weight of oxygen, deduced from experiment, and that admitted by hypothesis.

But the relation of hydrogen to oxygen is not known with certainty. From the *ensemble* of all the labours performed on the composition of water, on the specific gravity of hydrogen and oxygen, and on the proportional relation between chloride of ammonium and silver, I am led to believe that, hydrogen being 1, the atomic weight of oxygen cannot far exceed 15·96. If I proportionally reduce all the above-mentioned values, for the difference existing between 15·96 and 16·00—that is to say, $\frac{4}{100}$—I arrive at the following results:—

Hydrogen being	1
Oxygen is.	15·960
Silver	107·600
Nitrogen	14·009
Bromine	79·750
Chlorine	35·368
Iodine	126·533
Lithium	7·004
Potassium	39·040
Sodium	22·980

In this case the atomic weights of nitrogen and lithium are obviously represented by whole numbers; but those of oxygen, silver, chlorine, iodine, and potassium are so far removed from whole numbers or simple fractions, that it seems to me difficult, if not impossible, to discover in them a simple relation.

It follows, from all that goes before, that I have no reason to alter the conclusions with which I have ended my "*Researches on the Reciprocal Relation of Atomic Weights.*" The simplicity of relation of weight which Prout's hypothesis presupposes between the masses which intervene in chemical action, is not, then, observed in experience; *it does not exist in reality.* Indeed, *these relations, as they present themselves to us, are incommensurable.* Besides, M. Dumas, in the works on which the partisans of Prout's hypothesis build, now admits that the ciphers, deduced from experiment, with those which the English chemist's hypothesis presupposes, offer a more considerable deviation than can rightfully be attributed to an inevitable error of the observation. However, convinced as he is that this hypothesis is the expression of a *philosophical truth*, he considers Prout's law as a limited one analogous with those of Mariotte and Gay-Lussac. Reduced to these terms, the English chemist's hypothesis escapes the investigations of those who believe they ought to rely only on experience in searching out and establishing the laws which govern matter; it re-enters the domain of pure speculation, which can have nothing in common with the proceedings, the exigencies, and the principles of exact sciences.

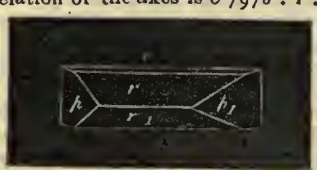
One word more, and I have finished. Prout's law not being verified by experiment, is it conformable to the true principles of science, to inscribe, in any works, atomic weights represented by *entire numbers or followed by simple fractions*, taking hydrogen for the unit? This is done by a great many chemists in the present day. In ordinary usage is it possible, without inconvenience, to make use of entire numbers, or those followed by simple fractions? The greater part of carefully determined atomic weights come so near to calculated ciphers, that it has been necessary to have recourse to all the arts and refinements of analysis, to prove that they are not absolutely exact. It is evident from this that in ordinary calculations they may be used. It is certain that the error committed will always be as little as or less than that which results, in the majority of cases,

* *Memoirs of the Royal Academy of Belgium.*

from the operation by which the calculation is intended to be verified. Besides, it naturally follows that in calculations the use of atomic weights brought more or less near to the truth, is correlative to the degree of exactitude desired. It ought to be, in the use of atomic weights, as with weights and measures themselves; although standard weights and measures are required, there is no utility or necessity in employing them where such a degree of accuracy as is presupposed by their use is not required. If I agree on this point with most chemists, I do not in that which relates to the substitution in some works of calculated or approximative atomic weights for those determined by experience. When the end in view is to instruct or to ascertain what is the reality of natural phenomena, it is no more allowable to substitute error for truth than it is possible to agree with a principle known to be untrue. . .

On the Isomorphism of Thallium-perchlorate with the Potassium and Ammonium-perchlorates, by Prof. H. E. Roscoe, F.R.S., &c.

The crystalline form of thallium-perchlorate is that of a right rhombic prism (pp_1), in which the faces of the rhombic octahedron (rr_1) and the basal faces of the prism (c) generally appear; the crystals being lengthened, as is the case with the alkaline-perchlorates, sometimes in the direction of the prismatic and sometimes in the direction of the octahedral faces. A careful measurement of the crystals gave the mean value of 102° 50′ for the angle pp_1, and that of 102° 6′ for the angle rr_1 on c. Hence the relation of the axes is 0·7978 : 1 : 0·6449.



The angles observed by Mitscherlich,* in the case of potassium- and ammonium-perchlorates, agree exactly with the above. For the first of these salts, $pp_1 = 103° 58'$, rr_1 on $c = 101° 19'$; and for the second, $pp_1 = 103° 11'$, and rr_1 on $c = 102° 4'$, giving the relation of the axes to be (1) 0·7817 : 1 : 0·6408, and (2) 0·7926 : 1 : 0·6410.

Ethylated Benzol,† by M. Fittig.—From monobromated benzol, and by the process already described, the author has obtained *ethylated benzol*, $C_{12}H_5,C_4H_5$. Boiling point 135°. By the gradual addition, at a low temperature, of its equivalent of bromine, it forms a bromated compound

$$C_{12}H_4 \begin{cases} C_4H_5 \\ Br \end{cases}$$

which can be isolated by washing in soda, dehydrating with chloride of calcium, and fractionally distilling. It boils without decomposition at 199°. With equal equivalents of the latter and hydrobromic ether, diluted with anhydrous ether, *diethylated benzol* is obtained

$$C_{12}H_4 \begin{cases} C_4H_5 \\ C_4H_5 \end{cases}$$

For this purpose the above mixture is treated with sodium in a well-cooled vessel. The new compound has an agreeable odour distinct from that of benzol. Boiling point 178°. With oxidising agents, such as fuming nitric acid and chromic acid, it forms derivatives, among which are acetic and terephtalic acids.

* *Pogg. Ann.*, xxv. (1832), p. 301.
† *Zeitschr. Chem.* ix. 358 (1866).

PHYSICAL SCIENCE.

Thermo-Electricity.

In the *Annales de Chimie et de Physique* for August last there is an article by M. Becquerel on the thermo-electric powers of different substances, and the construction of thermo-electric batteries. We give some of his results, which will doubtless prove interesting to our readers, as they comprise all that is yet known in this branch of electricity. To insure the accuracy of the results, great care had to be taken to keep each end of the bar to be experimented on at a constant temperature, usually 0° and 100° Centigrade. To effect this, two tin boxes were constructed, into the sides of which test-tubes were inserted, so that the ends of the bar could each be placed in one of the tubes, and the mouth then closed with plaster of Paris; one of the boxes was then heated by the vapour of boiling water, and the other filled with ice. To ascertain the comparative values of each experiment, a standard couple of bismuth and copper was constructed with which all the rest were compared, and as copper was one of the metals in every experiment, it was sufficient to fasten a copper wire to each extremity of a metal bar to convert it into a thermo-element. In order to have the same electrical conductivity in each comparison, the couple to be tested was placed in the same circuit with the standard bismuth-copper couple, and the intensity of the current observed first when the two couples were acting together, and next when they were opposing each other; then, by Ohm's law, half the sum of the intensities represents the proportional electromotive force of the experimental couple, and half the difference that of the normal couple. The standard pair was carefully compared with a Daniell's cell, and their points of junction being at 0° and 100° it was found that 207·2 of the former gave a tension equal to 1 of the latter; by these means the value of every couple could readily be obtained in terms of a Daniell's cell. The most remarkable of the results thus arrived at are given in the following table:—

Metal forming with copper a thermo-electric couple, the points of junction being at 0° and 100° Centigrade.	Electromotive force, that of one Daniell's cell being 1000.
Tellurium	+39·949
Fused sulphide of copper { Maximum	+32·762
Fused sulphide of copper { Mean	+18·130
Equal chemical equivalents of antimony and cadmium	+21·410
Ditto with one-tenth its weight of bismuth	+13·000
Equal chemical equivalents of antimony and zinc	+ 9·020
Ditto with one-tenth its weight of bismuth	+ 7·750
Antimony	+ 1·409
Iron wire	+ 0·950
Silver	+ 0·026
Copper	0
German silver wire	— 1·260
Nickel wire	— 1·630
Cobalt wire	— 2·240
Bismuth	— 3·909
10 parts of bismuth to 1 of antimony	— 6·197

The above table gives the electromotive force observed between each metal and copper, but to compare any two metals together it is only necessary to subtract the one value from the other, attention being paid to their respective signs; thus the action between tellurium and bismuth would be $39·949-(-3·909)=43·858$. The reciprocals of these numbers, multiplied by 1000, give the number of couples required to equal the tension of a Daniell's cell.

It is seen that the greatest electromotive force is possessed by tellurium, but its high price would prevent its being of any practical use in the construction of thermo batteries. Next to it stands sulphide of copper, the action of which will be further described. We then come to an alloy of antimony and cadmium (806 of the former to 696 of the latter); this is, however, like the similar alloy of antimony and zinc, too brittle to be used, and a mixture of a small quantity of bismuth is found necessary to give it consistency. This addition has the effect of considerably lowering the electromotive force, but as the latter still remains tolerably high, it is this mixture which M. Becquerel recommends as the positive element in cases where sulphide of copper would give too much resistance. The addition of a small quantity of antimony to bismuth renders it much more strongly negative, and also improves its mechanical condition, which it makes more consistent and homogeneous; for these reasons this is strongly recommended as the negative metal where a temperature of over 100° is not required. Where a much greater heat is to be applied, German silver will be found the most convenient, as it is easily procurable, and its force is not much inferior to that of pure nickel. In almost all cases, M. Becquerel has found that annealing the metals for some hours at a temperature of from 200° to 400° increases their power sometimes as much as 13 per cent.

Experiments were tried upon the sulphides of the metals, but especially upon that of copper, the action of which was found to be the most energetic of any. This sulphide is easily prepared by placing fragments of sulphur in a crucible which is heated over a fire. When the sulphur boils, plunge into the crucible a red-hot bar of copper; the action at once takes place, and when the sulphur is exhausted the sulphide is to be scraped off the bar, and the operation repeated. When sufficient has been obtained, it may be melted and cast into a bar; its melting-point is about the same as that of gold, or between 1030° and 1040° Centigrade. The bars should then be placed in a sand-bath and exposed to a dull red heat for several hours, after which they are allowed to cool slowly; by this operation their electromotive force is often increased ten times: this increase is far greater than is ever observed in the case of metallic bars.

Where a current of great quantity is required, the resistance of sulphide of copper may be found to be too great, and it is then better to use an alloy of antimony and cadmium, or antimony and zinc, with German silver as the negative metal when much heat is to be used. The numbers given in the former table are for a difference of 100° between the junctions; for any other temperatures the electromotive force may be roughly taken as proportional to the difference, but will usually increase rather more rapidly than the latter. The following is taken for a difference of temperature between the two junctions of about 400° Cent.:—

Elements of couple.	Number of couples required to give an electromotive force equal to that of one Daniell's cell.
Sulphide of copper and German silver .	Between 8 and 9 couples.
Equal equivalents of antimony and cadmium plus one-tenth the weight of bismuth, and German silver .	Between 10 and 15 couples.
Equal equivalents of antimony and zinc plus one-tenth the weight of bismuth, and German silver .	Between 15 and 20 couples.

The following are the conclusions arrived at by M. Becquerel:—

For piles to be used at low temperatures, such as those employed for measuring radiant heat, the negative metal should consist of 10 parts of bismuth to 1 of antimony; the positive metal should be as follows:—

Antimony . . .	806 } Equal equivalents.
Cadmium . . .	696 }
Bismuth . . .	$\frac{1}{10}$th the weight of the above.

For piles of a high tension the negative metal should be German silver, and the positive may be either the above mixture or sulphide of copper; the latter stands the greatest heat, but gives also the highest resistance. The sulphide should be used in bars of about 10 centimetres in length, 12 millimetres thick, and 18 wide; the ends should be coated with German silver, and wires of the same material screwed on, so as to unite the ends of each bar with the opposite ends of the next bars. A jet of gas is allowed to play upon a small plate of German silver, which is left projecting from one end for that purpose. As sulphide of copper is a very bad conductor of heat, it will scarcely be found necessary to cool the other ends; but this should be done when a metal is used, and the length of the bar should, in that case, be increased.

Thermo-electric piles, on account of their low tension, cannot yet replace hydro-electric batteries; but for special purposes, and particularly for the study of radiant heat, the piles here described offer new facilities, and are therefore worthy of attention.

Quinic Acid,* by M. Graebe.—This acid, which is by many of its properties allied to citric acid (see *Ann. Chem. Pharm.* xxxviii. 229), in others resembles the group of aromatic acids; for with hydriodic acid it gives *benzoic* acid; with bromine, *carbohydroquinonic* acid; with peroxide of lead, *hydroquinon*: the latter is also produced with heat; it is accompanied by *benzoic* and *phenic* acids. M. Graebe has himself transformed it into chlorinetted chloride of benzoyle by treating it with pentachloride of phosphorus. He has transformed it into carbohydroquinonic acid by melting it with three times its weight of caustic potash. Under these circumstances potash behaves in exactly the same way as bromine.

$$\underbrace{C_{14}H_{12}O_6}_{\text{Quinic acid.}} + 2HO = \underbrace{C_{14}H_{12}O_8}_{\text{Carbohydroquinonic acid.}} + H_2.$$

In constitution the author believes this acid to resemble hydrate of amylene.

On the Analysis of Alkaline Silicates,† by M. de Fellenberg.—According to the author, the best and most successful process for attacking alkaline silicates consists in using chloride of calcium pure, or with the addition of quicklime. For this a high temperature is necessary. The operation may, without fear, be performed in platinum. First melt the chloride of calcium, and incline the crucible so that the sides may be covered with it; after it has cooled, add the silicate, previously reduced to a fine powder; heat again, and keep the mass in fusion for at least ten minutes. After cooling, the product of the fusion may be easily detached from the sides of the platinum crucible; then extract with hot water, filter, and wash until the liquid is no longer rendered turbid by nitrate of silver. The solution will contain only lime and the alkalies, for the alumina, iron, magnesia, &c., displaced by the lime, will remain on the filter. Precipitate the liquid by carbonate and oxalate of ammonia, which removes the lime, leaving only the alkalies in solution.

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* *Ann. Chem. Pharm.* cxxxviii. 198.
† *Zeitschr. Chem.* 1866 p. 379.

REPORT ON THE

CHEMICAL LABORATORIES

IN COURSE OF ERECTION IN THE

UNIVERSITIES OF BONN AND BERLIN.

The Chemical Laboratories of the Rhenish Frederick William University of Bonn.

(*Continued from page 234.*)

The Upper Floor.

It has already been stated that only the front block of the building has a second story; this contains a splendid suite of apartments provided for the director of the institution. It would be superfluous to describe more fully its various parts, since a mere inspection of the ground plan (Fig. 4), and of the synopsis which accompanies it, will suffice to show everything that could be of interest.

It may still be mentioned, that there are a number of servants' rooms over the domestic offices, and a suite of inferior rooms over the upper floor of the left corner, intended for household purposes.

The drawing-room (*b*) in the right corner of the building is, as stated in the synopsis, considerably higher than the remaining rooms.

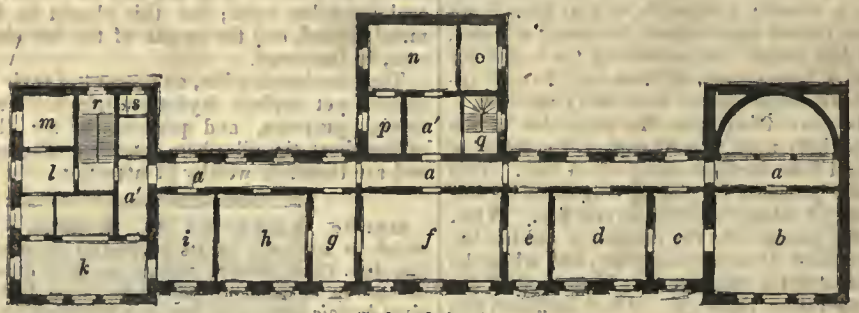
The slated roof overlying the front block of the building contains abundance of well-lighted storage-room.

The drawings which still remain to be described are partly sections, partly views, and although with the help of the ground plans they are readily intelligible, a few explanatory remarks may not be superfluous.

Fig. 5 represents a section along the longer axis of the building—that is, the line A B in the ground plans. In examining this very instructive drawing, we shall commence, as we shall with all the other sections, from the left side. We observe in succession the Mineralogical Museum with the door leading into it from the corridor; the Waiting Room for the Lecturer; the Apparatus Room, with the windows; and the Preparation Room for the Lectures, with the doors opening into the left front court.

Fig. 4.

Rooms on First Floor.



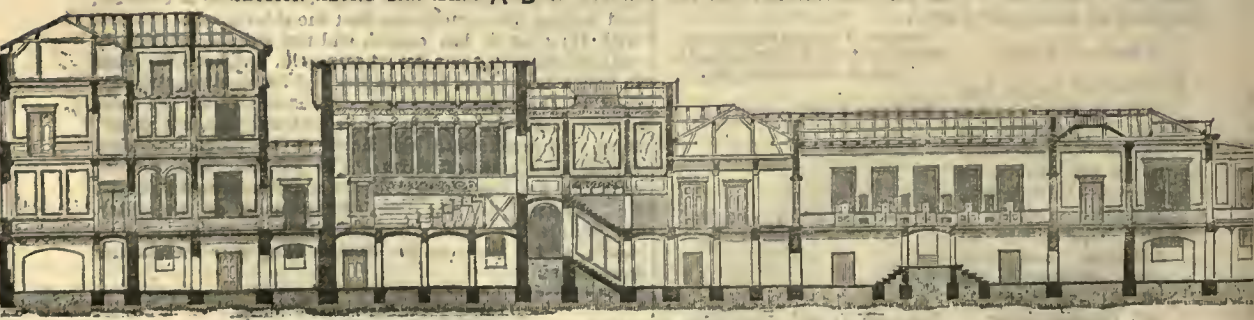
(Scale as before.)

Synopsis.

	Name of Room.	Length. ft.	in.	Breadth. ft.	in.	Height. ft.	in.
a, *a*, *a*	Main corridor and staircase	116	2	6	5	15	0
a', *a'*	Side-passages	...		...		...	
b	Ball-room	28	0	21	1	19	0
c	Sitting-rooms and bedrooms	18	1	11	3½		
d	Ditto ditto	19	2	18	1		
e	Ditto ditto	18	1	9	9		
f	Ditto ditto	29	5	18	1	15	0
g	Ditto ditto	18	1	8	11		
h	Ditto ditto	19	2	18	1		
i	Ditto ditto	18	1	12	1½		
k	Ditto ditto	28 (13	0)	11 (8	1 7)	14	0
l	Ditto ditto	11	8	9	2½	14	0
m	Sitting-rooms and bedrooms	11	11	11	8	14	0
n	Kitchen	17	0	13	10		
o	Small side rooms attached	13	10	8	6	11	0
p	to kitchen	12	6	7	6		
q	Servants' staircase leading up to servants' rooms over main suite, and down to court and household cellars	...		...		...	
r	Back staircase leading from ground floor to roof, and small rooms in left corner of front block	...		...		...	
s	Closet	14	2	6	2	14	0

Fig. 5.

Section along the Line A B in the Plans of the Ground Floor and Basement.



(Scale as before.)

Next come the Great Lecture Theatre, with its seats rising in tiers, and the range of elevated windows, only the first on the left descending to the level of the lecture-table; the elegant Staircase Hall, lighted by a skylight, and the landing by which students, having ascended the flight of steps, enter the lecture-hall; the Main Corridor of the middle cross building, with the door of the director's study in the background; the Side Passage leading to the middle laboratory, with the door to the attic staircase; the Middle Laboratory itself, with its five windows looking into the back court; the evaporation niches fitted up in the intervening piers, and the double working benches in front of the window recesses; the Passage to the laboratory for gas analysis, with the door of the ante-room; and lastly, the Gas-analysis Room itself, with part of its bay-window. This section shows, moreover, with great distinctness, the unequal height of the different apartments of the institution intersected by the middle axis.

Fig. 6 shows a section of the building parallel to the previous one, but lying to the right of it, along the line C D. In this drawing we see, on the ground-floor, beginning again from the left, first, in section, the Chemical Museum, with its door opening into the Mineralogical Museum; in elevation, the Waiting Room for the Lecturer, the Apparatus Room, the Preparation Room, and the Great Lecture Theatre; lastly, the Staircase Hall, with the Thoroughfare under the landing, which affords communication between the two forecourts. After this we have, again in section, the Main Corridor of the middle Cross building, with the door of the director's study in the background; and, farther, the balance room with the door leading to the room for fusions and ignitions; then follow, once more in elevation, the Middle Laboratory, with its five windows opening into the right back-court, and the thoroughfare running underneath it, and (in section) the Reservoir in the middle of the court. The Colonnade for open-air work with the steps leading up to it from the back court, and the door of the operation room of the middle laboratory, appear again in section. Finally we have an opportunity of glancing into the interior of the semicircular structure projecting from the building, and encasing the winding stairs which lead down to the basement passage between the two furnace-rooms.

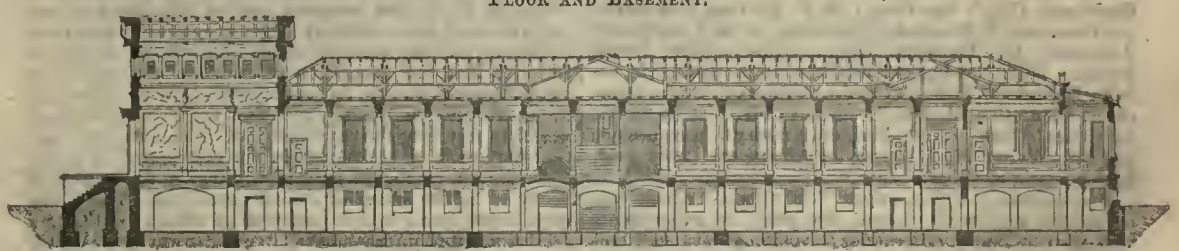
Fig. 6.

Longitudinal Section along the Line C D in the Plans of the Ground Floor and Basement.

(Scale as before.)

Fig. 7.

Section of the Middle Cross Building along the Line E F in the Plans of the Ground Floor and Basement.



(Scale as before.)

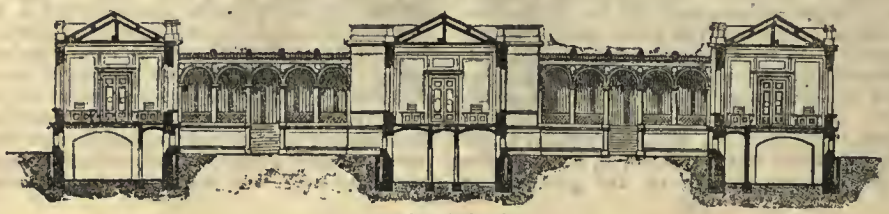
This section (Fig. 7) cuts the corridor of the middle cross building, the main artery of the institution, the observer looking from north-west to south-east—that is to say, in the direction from the laboratories towards the front block. Beginning, as before, from the left, we first find the outside flight of steps, leading through the principal entrance into the magnificent vestibule, the imposing style and tasteful decorations of which are visible from this sketch; the drawing exhibits also the elegant suite of windows running round the upper part of the walls, by which the vestibule is profusely lighted. The large door, seen just beyond the second column in the vestibule, leads to the corridor of the side wing containing the apartments of the assistants and the castellan. The vestibule passed, we have the main corridor in its full length lying before us. In addition to the light obtained from the eight windows shown in the drawing, this corridor also derives a good deal of light from the staircase. The walls opposite the windows and behind the spectator are ornamented with the busts of celebrated chemists, which, fully lighted as they are in this position, produce a particularly striking effect. This section also gives us a very clear insight into the position and construction of the staircase. The stairs, starting from an archway on two columns, lead to the landing repeatedly mentioned, and up to the theatre door, the lower part of which, in the drawing, is seen between the columns; on either side of these columns the ornamental balustrades which protect the landing are visible. Of the stairs, leading to the basement, the top of two side wings is seen in part only and from below; whilst the

central flight, lying parallel to and immediately under the staircase to the lecture-room, is given in full. At the end of the main corridor we perceive the folding-doors of the side corridor, which, leading by the director's laboratory, communicates with the front block of the building. Lastly, on the extreme right we find the director's study, with the door to the private laboratory, the side window facing the south-east, and part of the bay-window for microscopic investigation.

A few words will suffice for the description of this drawing (Fig. 8). Here the three laboratories are shown in section, and between them, in elevation, the colonnades for open-air work, with the flight of stairs leading down into the back courts. In the laboratories themselves the working benches, with their cupboards and shelves for reagents, are indicated. Lastly, between the benches are seen the three doors leading respectively to the operation-room of the third laboratory, to the passage communicating with the gas-analysis room, and, on the right, to the operation-room of the first laboratory.

Fig. 8.

Section along the Line G H in the Plans of the Ground Floor and Basement.



(Scale as before.)

(To be continued.)

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, November 15.

Professor W. A. Miller, *M.D., F.R.S., President, in the Chair.*

The minutes of the previous meeting were read and confirmed, and the library donations announced. Mr. William Chandler Roberts was formally admitted a Fellow of the Society, and the following gentlemen were duly elected, viz.:—Mr. William Herbert Gossage, Foot's Cray Soapery, Melbourne, Australia; Mr. Robert Biggs, Deputy-Coroner, 17, Charles Street, Bath; and Mr. David Page, Galebeck Powder Works, near Kendal. For the second time were read the names of the undermentioned candidates:—A. C. Cook, Ph.D., King's College, London; Henry Dircks, C.E., Whitehall Club and Bucklersbury; James Forrest, Ashburnham Road, Greenwich; William Huskisson, Gray's Inn Road; A. F. Marreco, Newcastle-on-Tyne, and J. Hancock Richardson, of the same place; Alexander M. Thomson, D.Sc., Sydney, New South Wales. The following candidates were proposed, viz.:—John Broughton, B.Sc., Chemist to the Government Cinchona Plantation, Madras Presidency; Mr. Watson Smith, Analytical Chemist, 26, Portland Crescent, Manchester; and Mr. Walter Noel Hartley, Pathological Laboratory, St. Thomas's Hospital.

Dr. Daubeny read a paper "*On Ozone*," which embodied the results of an extensive series of experiments and meteorological observations made at Torquay and Oxford. The tests employed to indicate the presence of ozone were the iodide of potassium and starch paper of Schönbein, and the moistened sulphate of manganese paper. The first, if protected from the light, was considered as furnishing the most reliable indications, although it was known to assume a blue tint by the action of free acids, chlorine, &c.; the second reagent indicated the ozone by the formation of brown hydrated peroxide of manganese. The apparatus employed consisted of a glass U tube screened from the light and connected with a Johnson's aspirator, and also with an intermediate wash bottle and gas meter. The volume of air drawn over the paper in the U tube was registered, and the resulting tint compared with a standard scale of coloration to indicate the amount of ozone. Thus measured, Dr. Daubeny found in the three winter months, commencing with January, 1864-5-6, at Torquay, that the south-west and westerly winds were most fully charged with ozone, whilst the north wind showed least; on the contrary, at Oxford, during the summer months of the same years, the easterly winds were most charged with ozone, and the north-westerly least. These indications clearly pointed to the influence of the sea in augmenting the amount of ozone at Torquay, whilst the more central inland position of Oxford caused the difference between the maximum and minimum indications to be much less apparent than at the seaside. The author then enumerated the various circumstances under which ozone is supposed to be generated, such as in the electro-decomposition of water, the action of sulphuric acid upon permanganate of potash, &c. His own experiments coincided with those of Dr. Gilbert in pronouncing the absence of ozone from the oxygen given off from plants exposed to sunshine whilst immersed in water. Dr. Daubeny then recounted the results of an examination of the air exhaled by growing plants, and found, in thirty-two instances out of fifty-seven plants experimented upon, sensibly larger amounts of ozone than in the surrounding atmosphere, and he was led thereby to consider that the generation of ozone in the process of vegetation was one of the appointed means of nature for the purification of the air, and that not only were plants useful in restoring the equilibrium of the atmosphere, but that they took an active part in the destruction of pernicious organic compounds given off either in the process of decay or by the waste of animal organisms. There was more ozone found near the sea than at inland localities, a greater amount in the country than in towns, and, lastly, more outside a building than in its inhabited rooms. The author referred to his previous researches (*Phil. Trans.*, 1834) as indicating the now commonly received view in reference to the part played by oxygen in the grand economy of nature, and now urged the necessity of seeking for more accurate tests and wider information before making specific statements or recording observations in the form of meteorological tables.

Dr. Williamson inquired whether any precautions had been taken in order to exclude the influence of volatile hydrocarbons and aromatic substances, some of which, like the oil of turpentine, seemed to unite loosely with oxygen, and then furnish the indications of ozone. He agreed with the author in feeling the importance of rightly estimating the action of ozone in the economy of nature.

The President desired to know whether Dr. Daubeny

had extended his observations to a full trial of the sulphate of manganese test for ozone. And, with regard to the influence of light in determining the oxidation of hydrocarbons, there were parallel instances in the cases of gutta-percha and india-rubber.

Dr. Franklann was anxious to learn whether or not ozone had the property of oxidising and destroying the vitality of the simplest forms of animal and vegetable organisms known as spores.

Dr. Daubeny replied that the outbreak of epidemics was often ascribed to a deficiency of ozone, but he had no evidence on the point. The action of hydrocarbons had, in his experiments, been guarded against by removing the test-paper to a greater distance in the case of plants exhaling aromatic odours, some of which had been examined, and he found it necessary to discard altogether the use of caoutchouc tubes for connecting the parts of the apparatus, since it quickly destroyed every trace of ozone. The action of light upon the test-papers was a matter of considerable importance, and he had been obliged for the present to omit the mention of some astounding results communicated by the Prior of the Monastery of St. Bernard, since he had no information as to whether the papers were exposed to the sun or shaded from its influence. The sulphate of manganese test was, he thought, inferior to Schönbein's paper; it likewise assumed a dark colour by the action of direct sunlight. In the case of the starch and iodide of potassium reaction, some of the iodine was no doubt dissipated without leaving its mark, and the observed effect was only the difference in the ratio of the action which sets the iodine free and the tension which causes it to evaporate into space. The speaker exhibited some pieces of dark blue fluor spar which when rubbed together gave an odour similar to ozone, but he found it possible to obtain from it some of the reactions of peroxide of hydrogen, particularly in its effecting the conversion of red chromic acid into the blue perchromic acid, so that he preferred giving this explanation, although it did not coincide with an opinion expressed by Liebig.

Dr. Gilbert referred to the published statements relating to the generation of ozone by plants, mentioned some anomalous results observed in the growth of fungi, and stated his belief that further evidence was wanting in order to establish the identity of the ozone-like emanations from growing plants and the odorous substance produced during the slow combustion of phosphorus in moist air.

Dr. Odling expected the manganese papers would have possessed an accumulating action for ozone, and served better than the iodide as a quantitative test. With respect to the odour evolved upon mixing permanganate of potash with an acid, he found that some of the properties of ozone were wanting; thus, heat had no effect upon it, potash absorbed it, litmus was coloured red, and some manganese appeared to be volatilised.

In answer to Mr. Newlands, the lecturer stated that it would be advisable to ascertain the degree and make allowance for the action of excessive heat upon the test-papers in hot climates.

The President, in moving a vote of thanks to Dr. Daubeny, pointed out the necessity of seeking for better means of indicating and registering the presence of ozone in the air; no one doubted the existence of this body, but the proof was as yet very imperfect.

Mr. W. N. Hartley then gave a short account of a new substance called "chlor-sulphoform," $C_2Cl_2S_3$, which he had prepared by the action of sulphydrates of potassium upon the chlorides of carbon. Its vapour density had not yet been ascertained. The author considered he had obtained evidence of the existence of a body having the formula $C_2Cl_2SO_2$.

The next paper, by Messrs. Chapman and Thorp, was a continuation of the one read at the previous meeting of the Society, entitled, "*The Relation between the Products of Gradual Oxidation, and the Molecular Constitution of the Bodies Oxidised.*" The substances operated upon in this instance were mannite and glycerine. The authors confirmed the statement that mannite, when heated with caustic potash, yields formic, acetic, and propionic acids, and observed that these acids were the same as those obtained by them in their oxidation of β hexylene. In the same way glycerine yields acetic and formic acids when treated with caustic potash. These acids are the same as those obtained by oxidising propylene—the olefine from glycerine. Both mannite and glycerine yielded nothing but formic acid, when oxidised with bichromate of potash and sulphuric acid. Permanganic acid produces the same effect. It was also observed that mannite decolorised an amount of permanganate solution sufficient to convert it entirely into formic acid and water, thus—$C_6H_{14}O_6 + 7O = 6CH_2O_2 + H_2O$.

Dr. Williamson did not consider the foregoing statement to be in harmony with the general view presented by the author on a former occasion. The method of oxidation was said to afford a means of splitting up organic bodies into a number of carbon groups; for his own part he thought Mr. Chapman had been fortunate in isolating from his products so many bodies of definite character, but the results must vary with the temperature and degree of concentration of the chromic solution.

Mr. Chapman was not prepared to admit a discrepancy between his present and former results. Acetic acid and some of the other products named would withstand for hours the action of the chromic solution at the temperature of boiling water, and he had specified the strength of the oxidising agent employed, which was chromate of potash with excess of sulphuric acid made so dilute that no oxygen was evolved from the mixture upon heating.

Mr. Chapman then read a paper, "*On the Synthesis of Butylene.*" The author alluded to Wurtz's synthesis of amylene by the action of zinc ethyl upon iodide of allyl. He then stated that he had succeeded in forming butylene by the action of zinc ethyl on mono-brom-ethylene, thus: $-Zn(C_2H_5)_2 + 2C_2H_3Br = ZnBr_2 + 2C_4H_8$. The butylene so obtained is a very mobile liquid, boiling between 12° and 14° C., and of sp. gr. ·739 at 0° C. It unites readily with bromine, and it was by the examination of the bromine compound that it was identified.

The meeting was then adjourned until Thursday, December 6, when the following papers will be read—viz., "*On the Alloys of Magnesium,*" by Mr. Parkinson; and "*On the Synthetical Formation of Formic Acid,*" by Mr. Chapman.

With reference to our report of the previous meeting of the Society, Mr. Chapman wishes it to be stated that the title of his paper then read is identical with the first of those now reported, and was not correctly described in the notice suspended in the hall of Burlington House. Since reading the former paper the authors have ascertained that the abnormal variety of valerianic acid (which gave butyric and carbonic acids upon oxidation) was *not* prepared, as at first supposed, from valerian root. It was an article of commerce of which they could not learn the history. The anomalous fousel oil which seems to contain two isomeric amyl alcohols is a rare variety believed to have been produced from grain with a certain quantity of rice in admixture. The conclusion deduced from the authors' results was "that by gradual oxidation of complicated carbon groups simpler ones are produced; that these simpler ones are capable of resisting the action of the oxidising agents which gave rise to them; and, finally, that these simpler groups are the representatives of the radicals entering into the composition of the bodies oxidised."

ROYAL SCHOOL OF MINES, MUSEUM OF PRACTICAL GEOLOGY.

A Course of Twelve Lectures on Chemical Geology, by Dr. Percy, F.R.S.

Lecture No. X.

(Continued from page 235.)

We will now consider the oxides of iron. Iron has, as you know, a very strong affinity for oxygen. When heated it will burn in oxygen gas, producing certain oxides of iron. When exposed to the action of moist air, it becomes rusty, or, in other words, combines with oxygen at the ordinary temperature, rust being only an oxide of iron.

The first oxide is the protoxide of iron. Of this compound in its isolated state nothing is known. It exists only in combination. There is a process described by a French observer for its production in a separate state, and we are told that the protoxide of iron is a very definite body; but still I do not think that these statements are very well sustained—at all events, they are not received by chemists generally. I have never seen a specimen of protoxide of iron, nor met with a chemist who had.

Perhaps the oxide most important for us in a geological point of view is the sesquioxide of iron—the common red oxide. Protoxide of iron has this formula—FeO. It contains one equivalent or twenty-eight parts by weight of iron, and one equivalent or eight parts by weight of oxygen. Sesquioxide is composed of two equivalents of iron and three of oxygen. It is analogous to alumina in that respect. It is a most beautiful mineral. You have two or three specimens of it on the table before you. It crystallises in the rhombohedral system, and forms that splendid mineral called specular iron ore. I may call your attention especially to one specimen in the museum above—one of the finest specimens, I suppose, in the world, of specular iron ore. It occurs in mirror-like laminæ—hence its name. It might be used as a looking-glass. Generally it is steel-grey in colour, and sometimes there is a beautiful iridescence, as there is in this Elba specimen. Elba has been known for some years as a source of this iron. On looking at this specimen, you would never take that to be red oxide of iron, but if you reduce it to powder, you will find that powder to have the characteristic red colour. In the mass it has a steel-grey metallic lustre. Every mineral composed of sesquioxide of iron gives a red powder, and the way to test it is to take a piece of broken pottery, and draw the mineral across the broken part; if the mineral is sesquioxide of iron, you will see a red streak on the broken edge of the piece of pottery. It cannot fail to produce it. We may obtain sesquioxide of iron by heating metallic iron for a sufficient length of time, exposed to the air, or by sundry indirect methods. If we heated sulphate of protoxide of iron (common green copperas) to a good red heat for a sufficient time, we should get sesquioxide of iron. It would then be in the state of what is called Calcutta rouge. It is the material used for polishing silver. It has to be prepared for that purpose with extreme care, or it would scratch the silver article. Much of the rouge which is sold by chemists is adulterated with mercury. This saves the time of the servant in cleaning the plate, but it soon causes its destruction. It is also used for the polishing of looking-glasses. Here is a beautiful micaceous variety, which we make by an indirect method, by heating together common salt or chloride of sodium, and sulphate of protoxide of iron, and then washing the product. It is not quite so steel-grey in point of lustre as the natural variety, but if you take a little of this between your fingers you will find it has the same kind of unctuosity as the variety we meet with in nature. We may form it also by heating anhydrous sesquioxide of iron in a slow current of hydrochloric acid, when it occurs crystallised. Or we may form it by heating a solution of chloride of iron with carbonate of soda and lime at 200° or 300° Centigrade. We here get double decomposition, and the sesquioxide of iron separated in the crystalline form.

Much of this specular iron ore is volcanic. It is found in the products of even modern eruptions of volcanoes. There is no doubt that that magnificent specimen in the museum, to which I have referred, is a volcanic product. Its formation may be accounted for easily by a method proposed long ago by Gustave Rose. Chloride of iron is a product of volcanic emanations. It is found in volcanic products undoubtedly. Sesquichloride of iron is, in fact, the perchloride of iron, and consists of three atoms of chlorine and two of iron. If we bring the vapour of water, which is oxygen and hydrogen, at a high temperature, in contact with this perchloride of iron, we get a double decomposition. The oxygen of the water passes to the iron, and we get sesquioxide of iron, which separates in a crystalline form. The hydrogen of the water goes to the chlorine of the perchloride of iron, forming hydrochloric acid; and thus we get hydrochloric acid, and this beautiful mineral sesquioxide of iron. I have here the result of a small experiment of this sort. It is not very satisfactory; but still there are indications of this crystalline sesquioxide of iron. Though the crystals are microscopic, they are there. There is no doubt that Gustave Rose's conclusion is the true one with regard to this specular iron one. We find sesquioxide of iron in nature which is not specular, and which does not require this hypothesis for its formation. It occurs abundantly in nature, sometimes filling lodes or veins—that is, great cracks or fissures in the earth. It occurs sometimes in great masses, and sometimes in regular beds. In Lancashire and Cumberland, for example, it is found on a very large scale. The Cumberland hæmatite, as it is called, and the Lancashire hæmatite are very well known. At Brixham, near Torquay, there is a large quarry of brown iron ore; but a little further on, at Sharkham Point, there is one of red iron ore. Then you may see it at Swansea, near the Mumbles, and it occurs in different parts of England, and largely in different parts of the world—Sweden, North America, and elsewhere. It sometimes occurs in great masses—kidney-shaped mammillated masses, having a beautiful fibrous or radiated structure. Here are some highly characteristic samples. It is associated frequently with quartz, sometimes with sulphate of baryta, and occasionally with both together—quartz and sulphate of baryta. The presence of free silica is a matter of great importance to the iron smelter; but I need not dwell upon that point. Sometimes it occasions great inconvenience. Some of the finest crystallised specimens of sesquioxide of iron occur in Elba and in Sweden. In Sweden, it not unfrequently accompanies magnetite. It occurs abundantly in Canada, and it occurs pseudo morphous after magnetic oxide of iron at Lake Superior and in Siberia. It is sometimes found pseudomorphous after iron pyrites—that is to say, the iron pyrites or bisulphide of iron has been subject to decomposition; and you will find the crystals to a certain depth transformed into red oxide of iron. I have here very characteristic specimens showing that conversion. Here you have it intermingled with the hydrated red oxide of iron—brown iron ore.

There is, I think, no difficulty whatever in understanding how iron pyrites should, by weathering action—the conjoint action of air and moisture—be converted into a hydrated peroxide of iron; but there is considerable difficulty in understanding how it should be converted into *anhydrous*, or waterless, peroxide of iron. This would seem to imply a comparatively high temperature. Whenever iron pyrites is weathered, the product always is brown iron ore—hydrated peroxide of iron—and never directly this red iron ore; and yet it is true that in certain exceptional cases we find upon the pyrites crystals of red iron ore instead of brown iron ore. That is a point which I do not think has been explained yet. It can only

be accounted for, I think, by exposure to a certain increase of temperature. I mention it particularly in order to excite attention to it. I have thought a great deal about this formation of the peroxide of iron in nature, and I must say that so far my conclusions are very unsatisfactory indeed concerning it. It is quite certain there are several conditions which must have concurred in its formation with which we are at present unacquainted, and I cannot help thinking one of the most prominent of these conditions is temperature—hot water, say, at a tolerably high temperature; but that is a point which I speak on with considerable reserve.

The next oxide we shall examine is this brown iron ore. It is nothing more, as I said, than red oxide of iron in combination with water. It exists abundantly in different parts of the world, and we have it largely in this country—in the Forest of Dean, for example, and also at Brixham. It occurs sometimes in Corwall, forming beautiful specimens highly prized by all mineralogists. There are several well-known varieties of it. The well-known mineral getite is nothing more than a beautifully crystallised specimen of it. The brown iron ores are all decomposed by a red heat, without exception. They lose their water and become converted into red oxide of iron. We can produce brown oxide of iron in the laboratory without difficulty. We have only to throw it down from solution by means of an alkali, or we can form it by the action of a current of air upon water containing bicarbonate of iron in solution. Perhaps this is one of the most important points for us to consider in connexion with the geological bearing of the question. The bicarbonate of iron dissolves to a large extent in water, but to a much larger extent in water containing carbonic acid, just as is the case with regard to carbonate of lime. Well, when that bicarbonate of iron is exposed to the action of the air—suppose it to trickle through cavities or fissures in a mine where air can get access—the first thing would be a deposition of carbonate of iron by the separation of carbonic acid, the carbonate of iron becoming insoluble upon the carbonic acid escaping. Then the air would act upon that carbonate of iron, and we should immediately get brown peroxide of iron. I have brought down this morning a beautiful stalactite showing this mode of formation perfectly; it consists of brown iron ore, having a beautiful concentric structure of thin concentric laminæ formed by the action of water in the usual way in which stalactites are formed. Those of you who have been at Hastings, I have no doubt, have seen the brown iron ore in the East Cliff there. It frequently occurs in lumps. It is carbonate of iron which has been exposed to air and moisture, and been converted on the surface into brown iron ore. Here is a specimen. It is carbonate of iron in the interior, but on the surface it has been converted into brown iron ore. Some of our recently discovered deposits of iron show this conversion beautifully. Here is an example in some of these pieces of iron pyrites, of which you may gather tons under the cliffs of Beachy Head. The pieces roll out of the cliffs, and are converted superficially into peroxide of iron. It is one of these singular things which, not many years ago, was mistaken for a thunderbolt, or meteorite. It is well to know this. A gentleman, a sailor of some distinction, was one day standing on the shore when a storm occurred. A flash of lightning struck a rock near at hand, and the result was, as he believed, the fall of a thunderbolt. He went forward and collected what he thought he saw fall, and, as he says, it felt hot and emitted the odour of sulphur. He went away and drew up what the French call a *procès verbal*, and forwarded it, together with the substance he picked up, enclosed in a mahogany box, to the government, stating that it was a true meteorite which he had seen fall. Well, on examination it turned out to be nothing more than one of these specimens which had fallen from the cliff. They are found in abundance at Beachy Head, and they occur also at the Isle of Wight. This story shows how careful people ought to be in such matters, and how necessary is a little knowledge of general facts to enable one to observe correctly. This man was, no doubt, perfectly honest, but he was grievously mistaken. To *see* is one thing; to *observe* is another and totally different thing. You cannot observe without a previous training of the mind.

An immense amount of this brown iron ore is now found in Northampton and in Oxfordshire. It consists essentially of brown oxide of iron—hydrated oxide. It is this ore which supplies the greater portion of the iron produced in France and Belgium, and it is now used as a source of iron in England. It is only a few years ago—since the Great Exhibition of 1851—that the ore was discovered in this country.

ACADEMY OF SCIENCES.

November 12.

The sitting this day was very short; and, with the exception of M. Berthelot's papers, little of general interest was brought forward. After some geographical and mathematical papers, one was read "*On a Method of Diminishing the Waste in Compressing Instruments, owing to the Heating of the Air*," by M. A. de Caligny.

"*New Details on the Ancient Monuments discovered in the Islands in the Bay of Santorin, and on the Actual Conaition of the Eruptive Phenomena*," by M. de Clgalla.

"*On the Action of Heat on Benzol and Analogous Hydrocarbons*," by M. Berthelot. (Second Part.) The author has continued the examinations which we noticed last week. When pure styrol is heated to redness, it decomposes with formation of benzol and acetylene; and reciprocally, when benzol is heated with acetylene, it produces a certain quantity of styrol. When styrol and hydrogen are heated together, the products are partly benzol and ethylene. When a mixture of atyrol and ethylene are heated, the products are benzol and naphthalin, both in great abundance. When styrol and benzol are passed together through a redhot tube, an abundant formation of anthracen takes place, together with some naphthalin and a hydrocarbon analogous to phenyl. Benzol and naphthalin at a red heat exert no reciprocal action. At a white heat there is an abundant formation of anthracen. Phenyl, $C_{24}H_{10}$, heated to redness in a sealed glass tube full of hydrogen, splits up with formation of benzol and chrysen,

$$3C_{24}H_{10} = 3C_{12}H_6 + C_{36}H_{12}.$$

"*On the Action of Potassium on Hydrocarbons*," by M. Berthelot. It is generally admitted that potassium and sodium are not attacked by the alkali metals; and indeed these have been employed to purify the hydrocarbons. The author, however, has recently observed that acetylene is energetically attacked by potassium and sodium, with formation of alkaline acetylides. Following up this reaction, M. Berthelot finds that a great many pyrogenous hydrocarbons, rich in carbon, are attacked by potassium, such as cumol from coal-tar, a liquid hydrocarbon of the same origin boiling between cumol and naphthalin, naphthalin, phenyl, anthracen, reten, &c. Styrol gives rise to special phenomena. The naphthalic compound, which may be taken as the type of the rest, is prepared and purified as follows:—Introduce naphthalin and a fragment of potassium into a tube, and heat to fusion. The potassium becomes covered with a black crust, and by breaking this off from time to time with a glass rod the whole may be transformed; no hydrogen is evolved. After dissolving the excess of naphthalin out with benzol, the result is a black powder, which, after removal of the excess of potassium, has a formula approaching $C_{20}H_8K_2$. Water decomposes it violently with formation of potash and a hydrocarbon much more fusible than naphthalin. These compounds appear to be explosive. The author

points out their relations with the blue compounds which are formed in the reaction of alkaline metals on chloro and bromo bodies.

"*On Diffusion and Endosmose*," by M. Dubrunfaut. The author draws attention to the fact that in 1854 he discovered a method of purifying saccharine liquids by a process somewhat similar to dialysis.

"*Chemical and Industrial Memoir on Buckthorn Seeds*," by M. J. Lefort. Chemists have already found in these seeds bodies which are known by the name of rhamnine, chrysorhamnine, xanthorhamnine, oxyrhamnine, and hydrate of rhamnine. The author has now added to the confusion by discovering, in "large quantity," rhamnegine and rhamnine. *Rhamnegine* is obtained by allowing to remain at a low temperature a concentrated alcoholic tincture of Persian or Avignon seeds. When purified, it forms cauliflower masses of yellow and translucent prismatic crystals. It is very soluble in hot water and alcohol. Sulphuric, nitric, and hydrochloric acids convert it into rhamnine. It unites with bases, and its formula is $C_{12}H_6O_5 + 2HO$. *Rhamnine* is obtained by boiling the seeds with water. The filtered solution abandons rhamnine under the form of a lively citron-yellow precipitate. With the exception of it being a little darker yellow, and being insoluble in water, rhamnine has the same properties and composition as rhamnegine.

"*On the Separation of Left-handed and Right-handed Tartratee by means of Supersaturated Solutions*," by M. Gerney. A supersaturated solution of left-handed double tartrate of soda and ammonia does not crystallise in contact with a fragment of the same salt right-handed, and *vice versâ*. From an inactive supersaturated solution of double racemate of soda and ammonia, a fragment of right-handed crystal determines only the precipitation of right-handed crystals; whilst a portion of the same liquid in contact with a left-handed crystal produces a deposit of the left-handed salt. This supplies a simple means of separating at will from the double racemate of soda and ammonia either of its two constituent salts.

CONTEMPORARY SCIENTIFIC PRESS.

[Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted.]

Dingler's Polytechnisches Journal. September.

"*On the Composition of a Deposit from a Steam Condenser*," by E. Reichardt.—"*On the Manufacture of Uranium Yellow at Joachimsthal, Bohemia*," by E. Vysoky.—"*On J. Young's Paraffin Oil Manufactory*," by G. Lunge.—"*On the Detection of Minute Traces of Fatty Substances by their Action in checking the Motion of Camphor on Water*," by J. Nickles.—"*Zymotechnical Miscellanies: 7. On Frozen Beer*," by J. C. Leimer.—"*On the Manufacture of Albumen from Blood*," by B. Richter.—"*On Disinfection as a Precautionary Measure against the Spread of Cholera*," by M. Von Pettenkofer.—"*Researches on Graphite*," by A. W. Hofmann.—"*A Solution for Etching Copper*," by C. Puscher.—"*Semi-Transparent Glass for Greenhouses and Forcing Pits*," by J. A. Heckert.—"*A New Glaze Free from Lead for Common Pottery Ware*," by E. Wiederhold.—"*On the Manufacture of a Certain Kind of Blue Paper*," by G. Dachauer.—"*On Scheibler's Process of Manufacturing Beetroot Sugar*," by the same author.—"*A Method of Etching and Colouring Buttons and other Articles of Horn*," by G. Mann.—"*On the Ventilation of Cesspools*," by Toussaint-Lemaistre.

Vol. 182. No. 1. October.

"*On the Influence of Light on Silvered Glass Mirrors*," by C. Lea.—"*On the Reducing Properties of Zinc*," by C. Stahlschmidt.—"*Historical and Practical Researches on the Nature of Purple of Cassius*," by J. C. Fischer.—"*Contributions to the Knowledge of Madder Colours*," by P. Bolley.—"*On the Application of Bessemer Steel to the Manufacture of Domestic and Culinary Utensils*," by F. W. Haardt.—"*On the Manufacture of Armour Plates in Austria*," by the same author.—"*On the Cast Steel Projectiles used by the Austrians at the Battle of Lissa*," by the same author.—"*On the Use of Iron instead of Copper Tubes in Sugar Manufactories*," by A. H. Schmidt.—"*On the Absorption of Oxygen by Alloys of Lead and Tin*," by P. Bolley.—"*Note on Chloride of Magnesia as a Bleaching Agent*," by P. Bolley.—"*On a Yellow Crystalline Substance obtained from Indigo*," by Crinsoz.—"*On Lesimple's Method of ascertaining the Presence of Burnt Bank Notes in Charred Ashes*," by R. Böttger.—"*Cement for Attaching Brass to Glass*," by Wiederhold.

Mittheilungen des Gewerbe-Vereins für Hannover. Nos. 3-4.

"*On the Influence of a Coating of Soot on Steam Boilers and Evaporating Pans*," by J. Noeggerath.—"*On a Method of Burning the Noxious Effluvia given off during the Operation of Boiling Bones*," by Stöss.—"*On the Behaviour of Silicium during the Process of Refining Iron*," by List.—"*Apparatus for Testing Petroleum and Solar Oil*," by the same author.—"*On obtaining Chloride of Potassium from Carnalite at Stassfurt*," by E. Fuchs.

Kunst und Gewerbeblatt. No. 6. June.

"*On Fluid Glycerine Soap*," by M. Heeren.—"*On a Method of obtaining Colourless Albumen from Blood*," by Kunheim.

No. 7. July.

"*On Graphite in Bohemia*," by V. Noback.—"*On the Chemistry and Technology of Fats*," by P. Bolley.—"*On the Manufacture of Albumen from Blood*," by B. Richter.

Génie Industriel. No. 190. October.

"*On the Reduction of Metallic Oxides*," by J. Rebse.—"*Alloys of Aluminium*," by P. Morin.

NOTICES OF PATENTS.

Preparing Gun Cotton. Frederick Augustus Abel, Royal Arsenal, Woolwich. Dated April 20, 1865.

This invention has reference to the explosive compound known as gun cotton. Such compound has heretofore been employed either in a loose, fibrous, or woolly state, or of late it has been spun into the form of rovings, yarn, or thread, and has then been formed into cartridges, either by winding, braiding, or weaving.

This invention has for its object to assimilate the physical condition of gun cotton as nearly as possible to that of gunpowder by mechanically converting it into a solid conglomerate state, and imparting to it either a granular or other suitable form that will present the exact amount of surface and compactness required for obtaining a certain rapidity or intensity of combustion.

The method of treating the gun cotton, which the patentee prefers to employ in carrying the invention into practice, is as follows:—First convert cotton wool by the processes now well known into gun cotton. For this purpose he prefers to use the cotton in the form of a loose roving. When the gun cotton has been purified from acid by washing in running water and in very dilute alkali, transfer it to a beating engine of the description commonly used in the manufacture of paper, where it is reduced to a pulp, which is then converted into solid masses, such as sheets, discs, cylinders, and other forms, either perforated or not, by any of the processes ordinarily employed for producing sheets, discs, cylinders, and other forms from paper pulp. A small quantity of gum or other binding material soluble in water may be mixed with the

pulp. To obtain any required degree of density of the solid gun cotton, subject the mass, whilst in a moist state, to the action of hydraulic or other presses, or of any other known arrangement of machinery for exerting the requisite pressure on the material.

To produce a granular structure the patentee either cuts the sheets, discs, and other solid forms into small pieces of the required size, or introduces the pulp, containing water and a small quantity of the binding material, into a vessel to which a vibrating motion is imparted, whereby the pulp is at once formed into granules of different sizes, which are subsequently sorted, if necessary. In the above processes, in place of water, other fluids, such as wood spirit, spirit of wine, ether, or mixtures of those liquids, with or without some binding material soluble in the liquid, may be employed.

Instead of forming the whole of the mass of gun cotton into pulp as described, a portion of the same may be left in the original state, and be mixed with the pulp in such proportions that, when subjected to the requisite pressure, such combination will become a solid conglomerate mass of the requisite density. Such solid gun cotton, whether formed of pulp only, or of pulp mixed with fibre, may also be coated or mixed with soluble gun cotton, known as collodion, applied in the form of solution.

The solidified gun cotton may also be formed of mixtures of gun cotton of different composition, the properties of which are well known—that is to say, of gun cotton which is soluble in mixtures of spirit of wine, and ether, and in wood spirit, alone or mixed with spirit of wine, and of gun cotton which is insoluble in those liquids, and the mixtures may be produced either by reducing both or only one of the varieties of gun cotton to pulp, leaving the other in a fibrous state, or by combining them when both are in the fibrous state. Such mixtures may be converted into solid masses, either by the aid of pressure alone (that is, when one or both varieties is or are in the form of pulp), or by making the soluble gun cotton present in the mixtures serve as a binding material by their treatment with the liquids above named, which act as solvents, in which case the mixtures may be consolidated with or without the aid of pressure. The patentee claims:—

First, reducing gun cotton to a pulp, and consolidating such pulp with or without the aid of pressure into the form of sheets, discs, granules, cylinders, or other solid forms, either with or without the admixture of binding materials.

Second, combining with gun cotton reduced to a pulp gun cotton in a fibrous state, and consolidating such mixture into sheets, discs, granules, cylinders, or other solid forms, either with or without the admixture of binding materials.

Third, combining soluble and insoluble gun cotton, either when both are in a state of pulp or when one is in a state of pulp, and the other in a fibrous condition, and consolidating such mixtures into cylinders, sheets, discs, granules, or other solid forms, either with or without the admixture of binding materials.

Fourth, subjecting mixtures of soluble and insoluble gun cotton, either when both are in a fibrous condition, or when both are in a state of pulp, or when one only is in the state of pulp and the other in a fibrous condition, to the action of solvents of the soluble gun cotton, either alone or with the employment of pressure, so as to effect the consolidation of the same.

Fifth, the application to the surface of the consolidated gun cotton of a solution of the soluble forms of gun cotton, or of shellac, or other suitable gums or resins.

It would be difficult to overestimate the value of this discovery. By its means the patentee has succeeded in moderating the violence of the combustion to almost any desired extent, and has thus removed the chief, if not the only, source of danger attendant on the use of this agent for warlike or sporting purposes. We understand that Messrs. Prentice and Co., of Stowmarket, are manufacturing gun cotton, in which a patent of their own is combined with the above, in the production of patent safety gun cotton which meets all the requirements so long demanded by the various scientific and practical authorities who have devoted their attention to this material. Under the new patents the safety gun cotton is so manufactured that it contains within itself the principles of safety and simplicity. Whilst, however, it is thus independent of mechanical aids, and under perfect control, strong shooting is effectually secured. The gun-cotton cartridges made by this firm on the above principle afford effective and, it is not too much to say, luxurious shooting. They are safe; give great penetration, with little strain upon the gun; make an excellent plate; emit no smoke; are uniform in power; occasion little recoil or noise; and neither foul nor injure the gun.

CORRESPONDENCE.

Spontaneous Ignition.

To the Editor of the Chemical News.

Sir,—The spontaneous ignition of pyrotechnical compositions made with chlorate of potass is indeed a very serious subject as regards the safety of both life and property. I know not if any reliable observations have been made in the matter, but the following facts were noted by myself some years ago, and may throw some light upon the probable origin of various terrible fires which have occurred on the premises of firework-makers in London. Mixtures of the three ingredients—nitrate of strontia (or barytes), sulphur, and chlorate of potash—if made up at once from *freshly* and strongly desiccated materials, are certain to take fire spontaneously within a few hours, especially if placed in a rather damp situation. The action, which I twice had the patience to watch for and witness, begins with the evolution of an orange-coloured gas; afterwards a liquefaction is set up at several points in the mass; a hissing noise and a more rapid disengagement of the gaseous matter comes on, and the composition takes fire. It is a curious thing that the addition of a small proportion of sulphuret of antimony at once prevents the occurrence of these phenomena; whether charcoal has the same effect I am not quite sure. Moreover, if such compositions, being damp, are, in order to dry them, placed too near the source of heat, the same phenomena will take place even when antimony is used in their composition. Also, compositions to produce a purple flame, if made with black oxide of copper, are almost sure, sooner or later, to take fire of themselves at uncertain periods, whether kept in a damp or dry place. The carbonate should always be used in preference.

I am, &c. R. Trevor Clarke.

Welton Park, November 13.

The Endurance of the Atlantic Cable.

To the Editor of the Chemical News.

Sir,—I have closely inspected the samples of Atlantic cable, both of 1865 and 1866, now being publicly exhibited at the Crystal Palace, and venture to express an opinion that the zinc or "galvanised" coating of the iron wires in the latter construction will eventually prove a source of weakness from the circumstance that this metal is rapidly attacked by sea water with formation of oxide and soluble chloride of zinc.

More than ten years ago I made a series of experiments upon the corrosion of sheet zinc and galvanised iron by fresh and salt water, in consequence of having had submitted to me an extraordinary instance of the destruction of a zinc-lined trough which had been inadvertently employed for the salting of meat. The animal fluids extracted from the meat appeared certainly to have had the effect of

stimulating the action of the brine upon the metal, but it was found that salt water alone rapidly attacked zinc, and the use of the metal was at once discarded. Assuming this action will occur in the outer strands of the cable of 1866, there is nothing to prevent the subsequent corrosion of the iron wire itself, and the structure of this metal will have been to some extent impaired or opened out by the treatment to which it has been subjected in the galvanising process. Granting the possibility of attaining a higher standard of tensile resistance by passing the iron wires through a careful annealing treatment applied in the shape of a bath of melted zinc, the increased mechanical strength may, nevertheless, have been dearly purchased by the sacrifice of superior chemical qualities which are undoubtedly presented in the hard, smooth, and bright wire of ordinary manufacture to greater perfection than in the roughened exterior of a once galvanised wire with its iron laid bare either by the intentional removal of the zinc with solvents, or by the equally certain action of salt water.

The advantage of using hemp in the natural condition, instead of the tarred material formerly employed, likewise appears to me to be very questionable when their relative merits are examined from a chemical point of view.

I am, &c. JOHN SPILLER.

Chemical Department, Woolwich, November 19.

Dr. Will's Analytical Tables.

To the Editor of the CHEMICAL NEWS.

SIR,—In answer to T. Williams' query, I quote this passage from the Preface to Connington's "Handbook of Chemical Analysis" :—

"The analytical tables, especially, are little more than translations of those which accompany Dr. Will's manual."

I am, &c. T. STEVENSON.

November 17.

Parish Analyses.

To the Editor of the CHEMICAL NEWS.

SIR,—I beg to call your attention to the enclosed copy of the last report of the "Medical Officer of Health" for Merthyr, particularly to that portion of it which purports to contain the results of an analysis of several specimens of well-water in the town and district. One sentence especially is worthy of remark :—"Organic matter exists in water in three forms, as *sulphate*, or *chloride*, or *nitrite* of lime, or magnesia." Even granting that sulphates and chlorides were sometimes produced in water by decaying organic substances, how could any one say for certain that their presence proved the presence of organic matter? In fact, such a statement, if correct, would annihilate the distinction between organic and inorganic salts.

Much attention is now being paid to the presence of organic matter in water as a source of disease, and it is certainly very proper that such wells as contain offensive decaying substances should be closed; but it occurs to me that neither the interests of science nor the interests of society will be promoted if our local boards condemn water on such evidence as I now lay before you. You may not be aware that the authorities at Cardiff had been recommended by (I believe) Dr. Pain to stop up certain wells, one of which was stated (after an analysis by Mr. S., of London) to contain "3·09 grs. of organic matter and loss" per gallon; but Mr. W. Herapath, sen., of Bristol, has examined the same water, and stated that it contains only ·048 gr. of organic matter per gallon, and that the method by which Mr. S. had obtained his results was a fallacious one—viz., that of incineration. Dr. Pain, of Cardiff, had also asserted that nitrites are indicated by the loss of colour experienced on adding permanganates, an assertion which Mr. Herapath of course contradicts.

As our medical officer is a gentleman highly and deservedly esteemed for his personal worth and medical skill, I do not write to give greater publicity to any error he may have committed; but, as an amateur chemist, I feel deeply interested in everything connected with chemical science, and regret that any discredit should be brought upon it by persons not properly qualified undertaking analyses, and having the results of their analyses accepted as sufficient evidence on which public boards may put a community to expense by closing up private wells or making other alterations. It is not long since a woman who died suddenly near Merthyr was reported, not by a professional analyst, but by a surgeon, to have taken arsenic, and, on the strength of his evidence (the result of his own analysis), a verdict equivalent to *felo de se* was brought against the deceased. This is not a healthy state of affairs; and as it is probably not uncommon to employ men as analysts whose only certificate is public opinion, it would be well to discourage our coroners, public boards, and others from accepting any analysis in cases of importance, unless it be duly certified by a professional chemist.

I am, &c.

F. SOULEY JOHNSTONE,
Minister of Market-square Chapel.

34, Thomas Street, Merthyr, November 20.

MISCELLANEOUS.

Medlock's Patent.—Messrs. Nicholson and Co. have applied for a disclaimer to this patent. The case has just come before the Solicitor-General.

ANSWERS TO CORRESPONDENTS.

General Index to the First Fourteen Volumes of the CHEMICAL NEWS.—We have had an inquiry for such an index. Its compilation will be attended with considerable trouble and expense; if, however, we find our readers generally wish for one, it shall be commenced as soon as the present volume is completed. Intending subscribers will please notify their wishes to the publisher without delay.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

S. R.—You need not add any nitric acid. Heat equal weights of oil of vitriol and copperas together to a heat short of redness.

J. R. W. S.—There is probably water in the gaspipe. Try turning the tap near the burner on full, and turning off the tap at the meter.

Manufacture of Iodine.—*A Subscriber* writes to say that if we supply him with the names of manufacturers of iodine, he can give some valuable suggestions in reference to the manufacture of the same.

W. L. R. inquires why it is that bone tallow becomes darker in colour after being heated on a water bath to 212° for one hour. Can any of our readers give the required information?

Prof. H. Wurtz, New York.—Our correspondent's letter, with enclosure, has arrived, and shall receive immediate attention.

Dr. T. E. Jenkins, Louisville.—We have to thank this correspondent for a most admirably executed series of stereoscopic photographs of the interior of the Mammoth Cave of Kentucky, taken by means of the magnesium light. The information given in the accompanying letter is so interesting that we regret it is marked, "not for publication."

W. H. Harrison.—1. Our experiments on the action of the rays of the spectrum on the different salts used in photography are published in the first volume of the *Journal of the Photographic Society*. 2. Inquire of Hopkin and Williams, New Cavendish Street.

W. Chisholm.—If a liquid would be applicable to your purpose, we would suggest the employment of bisulphide of carbon or the more volatile portions of paraffin oil or coal naphtha. These will entirely extract oil or grease from wool or cotton without injuring the fibre; and as the solvent can be almost entirely recovered by distillation, the loss would be trifling.

J. Johnstone.—Oil for tempering should be animal, as whale or fish oil. Tallow is good for small tools. Any steelworker or dealer will direct you to the best quality of steel for the tools you wish to make and the work you wish to do.

Naturalist.—A good hydraulic cement for your aquarium can be made from powdered pipe-clay, three parts by weight, to one of oxide of iron, mixed with boiled linseed oil sufficient to form a paste. Aquariums put together with thin strips of india-rubber in the joints are, however, preferable.

Received with thanks.—H. Deane, F.L.S.

Books Received.—"The Elements," by William Leighton Jordan; "Etudes et Considérations sur la Nature des Eléments (Corps non-décomposés) de la Chimie," par J. A. Groshans, première partie; "On Exuberant Growths of the Tonsils," by James Yearsley, M.D., M.R.C.S.

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PATENTS.

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CRYSTAL COD-LIVER OLEINE.

VERBATIM REPORT ON, AND ANALYSIS OF, THE CRYSTAL COD-LIVER OLEINE,
By WILLIAM ALLEN MILLER, Esq., M.D., F.R.S.,
Treasurer of the Royal Society, Professor of Chemistry at King's College, and Assayist to the Royal Mint.

(Copy.)

King's College, London, 17th October, 1866.

SIRS,—

COD-LIVER OIL.

In compliance with your request, I have analysed a sample of Cod-liver Oil, labelled as follows:—

CRYSTAL COD-LIVER OLEINE;
Imported under Seal by the Refiners, and Sole Proprietors,
BEDFORD BROTHERS,
87, Tower-hill, London.

The Oil was clear, of a pale yellow colour, with a very slight fishy odour and taste, presenting all the ordinary characters of Cod-liver Oil of fine quality.

Specific gravity .. .. 0·925.

It may be cooled down below 50° F. without becoming opalescent; but at a few degrees above the freezing-point of water it becomes thickened and loses its transparency, which it completely recovers again as the temperature rises.

As will be seen from the subjoined Analysis, it contains scarcely anything soluble in water or alcohol, and very little biliary matter.

The details of the analysis are as follows:—

Olein, with a little stearin in solution	99·490
Biliary matter, soluble in water	0·052
Matter, soluble in alcohol	0·458
Iodine	Traces
	100·000

I am, Sirs, yours truly,

To Messrs. Bedford Brothers. (Signed) WM. ALLEN MILLER.

The CRYSTAL COD-LIVER OLEINE may be procured, in Bottles, at 2s. 6d. and 4s. 6d. each, of Messrs. Barclay and Sons, Sutton and Co., W. Edwards, J. Sanger and Son, Cleaver (late Hannay and Co.), J. Robbins and Co., of Chemists generally, and Wholesale of the Importers,

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Conclusion.

I must now stop, for my task is completed. I have tried, in the most diverse compounds and in the most varied reactions, to pursue this alliance between organic and inorganic chemistry, which all have proclaimed, but which few have hitherto tried to establish in a definite manner. In the preceding pages I have pointed out many analogies, and I have sought to express them in that typical notation which is so clear when we have to represent the ties of relationship existing between bodies. I have laid stress upon some of the fundamental data of that which is now called the *new chemistry*. But it may be wrong to call it so. For this chemistry is simply that of Lavoisier, and if during ninety years the science he created has received a magnificent development, it owes it not to a revolution but to a continuous progress; the chain of this progress has never been broken.

At the end of last century the facts concerning the composition of acids, of oxides, and of salts, composed almost the whole domain of chemistry.

Theoretical ideas relative to the composition of compound bodies in general were founded upon the study of the reactions which give rise to the oxygenised compounds, particularly to salts.

We can sum them up thus: All chemical compounds are formed by the addition of two simple or compound elements; all compound bodies have a binary constitution. This is what was called dualism.

Berzelius adopted this doctrine, and sought to strengthen it by basing it upon the facts relating to the electrolytic decomposition of salts. The electro-chemical hypothesis became the support of the dualistic hypothesis. "You see plainly," said this master, "that salts contain the elements of the acid side by side with those of the oxide, and not confounded with them; for when we submit to electrolysis such a salt as sulphate of soda, the sulphuric acid, or the electro-negative element, goes to the positive pole, and the soda, or electro-positive element, goes to the negative pole." Thus the dualistic formulæ of sulphate of soda

$$SO_3 + NaO,$$

and of salts in general appeared strengthened, not only by the facts relating to the synthesis of these compounds and their most ordinary mode of formation, but also by the decomposition which the electric current causes in some among them. We now know that the argument is bad, and that it may be turned against the hypothesis which has been so long in vogue as to the constitution of salts. We know that in the electrolysis of sulphate of soda, as in that of sulphate of copper, it is not the oxide but the metal which goes to the negative pole, and that the free alkali only appears as the result of a secondary action — namely, the decomposition of the water by the metal around the negative electrode.

But that was not known in 1834, and since this epoch have been discovered the facts which should ruin the dualistic hypothesis of the constitution of compound bodies. M. Dumas proved that chlorine can unite with organic bodies otherwise than by addition—that is to say, by substitution; that chlorine, an electro-negative element, can there replace hydrogen, an electro-positive element. Berzelius rejected the most natural interpretation of these facts, and sought to express the composition of the chlorised organic bodies by dualistic formulæ. Thus trichloracetic acid was looked upon as a combination of chloride of carbon and of oxalic acid—

$$C_2Cl_3 + C_2O_3 + HO.$$

Trichloracetic acid.

Formulæ analogous to the preceding, and often more complicated, were attributed to the numerous products of substitution with which the labours of Laurent and of MM. Regnault and Malaguti had enriched the science. Berzelius had never before shown himself so fertile in hypotheses, and the resources of his powerful mind were wasted on this thankless task; by torturing facts to adapt them to his theory, he hastened the ruin of his ideas.

The French school has reacted against these exaggerations. M. Dumas, Laurent, and, later still, Gerhardt, entered into an energetic and victorious conflict with the author of the electro-chemical theory. Organic bodies are formed by groups of atoms united together by the bonds of affinity, and forming a whole; M. Dumas first stated this fact; Laurent and Gerhardt, adopting and developing this idea, made it the foundation of their theoretical conceptions; it is the basis of the *unitary system*.

But, as always happens, some have gone too far in this reaction. By saying, about ten years since, that simple or compound bodies can only react upon each other by exchanging their atoms, and by summing up chemistry in these words—All is double decomposition—Gerhardt himself exaggerated.

Yes, all is double decomposition in a large number of reactions, when molecules, which we may look upon as saturated, come into conflict with each other. In each of them, taken separately, the affinities of all the atoms are satisfied, and the forces which unite them are exhausted. But when they are put in contact, this state of equilibrium may be broken, and exchanges of atoms may take place, by virtue of that elective affinity of which Bergmann spoke a century ago.

But all is not double decomposition when we have to do with reactions between bodies which have not arrived at the state of saturation. A combination which contains one or more polyatomic elements whose affinities are not satisfied, may unite with new elements by virtue of the tendency which atoms possess to manifest and exert to their full extent the chemical forces which reside in them. Here it is not an exchange of atoms which forms the reaction—it is an addition of atoms. New affinities have revealed themselves and have been satisfied; the molecular edifice has increased.

Such reactions show that the combining power of the atoms is not exhausted at once, but that it is exerted by degrees. This combining power is now called atomicity. It is the basis of the modern theoretical ideas. If we wish to express in general terms the relations existing between bodies, shall we still say with Gerhardt that all should be compared with three or four substances chosen as types and able to be modified indefinitely by means of substitution? No; we can turn to a higher principle and say—

That the quantities of matter which act in chemical phenomena, and which have been called atoms, are not endowed to the same extent with the force which governs combinations.

That the diversity in the manifestation of this force, sometimes simple, sometimes multiple, gives rise to different forms of combination.

That in a given compound representing some one of

these forms, all the atoms are united by a part or by the whole of the affinities which reside in them.

Finally, that this affinity is exerted not only between heterogeneous atoms, but also between atoms of the same nature.

In the diversity of forms of combination we again see the typical idea, but this idea is now only of secondary importance; it is subordinate to a more general principle.

The theory of types, suggested by an attentive study of a large number of metamorphoses, confined itself to comparing bodies together, and represented them as being derived the one from the other by substitution. We now go further, and determining in what manner affinity joins the atoms together in a given compound, we endeavour to define the relationships which exist between these atoms. But who does not also see that this theory of atomicity which we have endeavoured to explain is only the invigorated and developed expression of the law of multiple proportions? Who does not see that contemporaneous chemistry, by considering so attentively the action of affinity in combinations, and especially in those molecular additions which Gerhardt had neglected, has made in a manner a return towards the past? We may thus say that the ideas which now tend to prevail stand midway between the ancient theories and those developed by Laurent and by Gerhardt.

The Polymeres of Acetylene: First Part—Synthesis of Benzol, by M.* Berthelot.

Most organic compounds may be arranged in two fundamental series—namely, the series of fatty principles, in which the weight of carbon is about six times that of hydrogen, and the series of aromatic principles, in which the relative proportions of carbon and hydrogen are about double the preceding. Without insisting on this relation, I will simply mention that the aromatic series comprehends most of the natural essences and the acids derived from them, the phenols and hydrocarbons of coal-tar, aniline, and probably a great number of therapeutic alkaloids and colouring matters—in short, the constituent principles of nearly all balsams, resins, bitumens, &c. Now, all these compounds may be theoretically connected with benzol, and in a great many instances by experiment. Benzol is, in a measure, the keystone of the aromatic edifice. This will show the importance of the synthesis of benzol, and I have carefully studied this formation.

From the beginning of my work in 1851, I have shown that benzol is formed by the action of heat on alcohol; having since formed alcohol from olefiant gas, and olefiant gas from its elements, the experimental production of benzol from carbon and hydrogen will be found demonstrated. But the compound was thus obtained under complicated conditions, in a manner to throw little light on its constitution.

However, my researches on acetylene caused me to think that this carbide might be the true generator of benzol. In fact, acetylene offers that proportion of weight between carbon and hydrogen which I have given as proper to the aromatic series. Moreover, acetylene and benzol are formed of carbon and hydrogen in exactly the same proportion; the condensation alone is different, for one litre of benzol vapour contains the same vapours as three litres of acetylene—

$$C_{12}H_6 = 3C_4H_2.$$

* *Comptes Rendus*, xliii., 479.

I mentioned the first confirmation of this theory, after comparing the decompositions of chloroform and bromoform by copper, at red heat.† The decomposition of chloroform, in fact, engendered acetylene by a regular reaction—

$$2C_2HCl_3 + 6Cu_2 = C_4H_2 + 6Cu_2Cl,$$

while that of bromoform engendered a certain proportion of benzol—

$$3(2C_2HBr_3 + 6Cu_2) = C_{12}H_6 + 3(6Cu_2Cl).$$

Benzol here seems to result from a condensation of nascent acetylene. However, this experiment, though published several years ago, does not appear to have attracted the attention of chemists.

The present memoir will, I hope, complete the demonstration of the synthesis of benzol and of its true constitution. I wish, in fact, to prove that benzol may be obtained directly, and in large quantities, by the condensation of free acetylene.

Acetylene, heated to about the temperature for fusing glass, is gradually transformed into polymeres; I described this experiment in the *Comptes Rendus*, lxii., 905. I have repeated it and accumulated the products, to enable me to make a thorough examination, and, after a series of careful, methodical manipulations, obtained a sufficient quantity of a yellowish liquid, which I submitted to a fractional distillation. I isolated a whole series of carbides of hydrogen, polymeres of acetylene (benzol, styrol, fluorescent carbides, retene).‡ I will now speak only of benzol, the most important and the most abundant of these carbides, reserving the others for a future memoir.

Benzol forms nearly half the total product, and is characterised by the following properties:—

1, Boiling-point, about 80°; 2, odour; 3, power of remaining unaltered by concentrated sulphuric acid; 4, after having been in contact with this acid, it is unalterable by iodine, and bromine does not immediately attack it; 5, introduced into a chlorine atmosphere, in the sun, it rapidly forms Mitscherlich's chloride, $C_{12}H_6Cl_6$, a characteristic crystallised compound; 6, fuming nitric acid dissolves it entirely when cold, changing it to nitrobenzol, a liquid perfectly soluble in ether, and having the odour of bitter almonds; 7, this nitrobenzol may be transformed into aniline by acetic acid and iron; 8, finally, aniline may be changed to the well-known and perfectly characteristic blue compound under the influence of chloride of lime.

The formations of nitrobenzol, aniline, and the blue colouring matter, are so sensible, that the transformation of acetylene into benzol may be seen, by operating on 30 and even on 10 cubic centimetres (12 milligrammes) of acetylene, which renders the demonstration of this fact possible in a course of experiments.

These facts explain why the formation of benzol and acetylene by the action of red heat on organic matters is always simultaneous. They are so much so that acetylene obtained in this way always retains, even after having passed through the cuprous combinations, some traces of benzol, as, by merely shaking 1 litre of this gas with 3 or 4 cubic centimetres of fuming nitric acid, an appreciable quantity of nitrobenzol, transformable into aniline, &c., may be obtained. But the proportion of nitrobenzol is very small, as the experiment fails with less than $\frac{1}{4}$ litre of acetylene. Nitrobenzol is really produced by pre-existing benzol; for acetylene, after

† "*Leçons sur les Méthodes générales de Synthèse*," p. 309.

‡ There was besides a small quantity of naphthaline, and probably of diacetylene.

having been treated by nitric acid, precipitated again by the copper reagent, then regenerated, furnishes no further trace of nitrobenzol. I repeated, with the acetylene thus purified, the synthesis of benzol; it succeeded exactly as before.

The result of these facts is that benzol is triacetylene. It may be obtained by the direct condensation of acetylene. Now, I have prepared acetylene by the direct combination of carbon and hydrogen; the synthesis of benzol from its elements results thus from two experiments, connected by reasoning one with the other. To fully demonstrate this synthesis, I have endeavoured to establish a connexion between the two experiments. To this end, I prepared some acetylene by the direct combination of pure carbon and hydrogen; I collected it in the form of acetylide of copper, restored it to the free state, and submitted it to the action of heat. It behaved exactly like the acetylene of the preceding experiments, and furnished benzol, which I submitted to the same tests. It will be seen that in this experiment I realised, on the elements themselves, the two successive transformations which produce, the first, acetylene

$$4C + 2H = C_4H_2;$$

the second, benzol

$$3C_4H_2 = C_{12}H_6.$$

The synthesis of benzol from its elements is thus demonstrated by the most simple and direct experiments.

Acetylene is then the generator of benzol—that is to say, of the fundamental centre of the aromatic series; it is, moreover, the generator of ethylene—that is to say, of one of the fundamental centres of the fatty series, this being the extent of its chemical relations.

I will now say a few words on the theory of the transformation of acetylene into benzol or triacetylene. The only carbides capable of producing polymeres § are the incomplete carbides, or those capable of uniting, by the addition of hydrogen, with bromine, or hydracides. Acetylene fulfils this condition. It is thus able to fix a gaseous volume equal to its own or double its own volume—

$$C_4H_2 \quad . \quad C_4H_2(H_2) \quad . \quad C_4H_2(H_2)(H_2)$$
$$C_4H_2(HI) \quad . \quad C_4H_2(HI)(HI)$$

In the latter case the compounds formed offer the characteristics of saturated bodies—that is to say, incapable of uniting by addition of other bodies. Now benzol is obtained by the addition to a molecule of acetylene of two other molecules occupying the same volume; it in certain respects resembles hydride of ethylene—

$$\text{Hydride of ethylene} \quad . \quad C_4H_2(H_2)(H_2)$$
$$\text{Benzol} \quad . \quad . \quad . \quad C_4H_2(C_4H_2)(C_4H_2) \quad .$$

the first generating molecule being equally saturated in the two compounds.

It is probable that the condensation of acetylene into benzol may be accompanied by disengagement of heat, all polymeric condensations being true combinations.‖ This disengagement may be so much the more considerable as the polymere may lose most of the properties of incomplete carbides, assuming those of saturated bodies.¶ Direct experiment is not made under conditions which would allow the verification of this conjecture; but it agrees with inductions I made relative to the thermochemical formation of acetylene and benzol,** the first body being most likely formed originally from its elements with an absorption of about 40,000 atoms of heat, while the formation of benzol would take place with almost no disengagement of heat. There would then be a disengagement of 40,000 atoms of heat at the time of the metamorphosis of acetylene into benzol.

If acetylene be really formed with absorption of heat, this would sufficiently account for exceptional aptitude for entering into reaction possessed by this carbide, and the extraordinary plasticity of its molecule; for by reason of this characteristic acetylene ought to cause disengagement of heat—that is to say, to do positive work by reacting on most other substances, exactly as do usually the simple bodies themselves.

§ See my "*Leçon sur l'Isomérie*," read before the Chemical Society of Paris.

‖ See my "*Researches on the Amount of Heat disengaged in the Formation of Organic Compounds*" (*Annales de Chimie et de Physique*, vi., 350, and "*Leçon sur l'Isomérie*," p. 33).

¶ Same *Researches*, p. 355, and "*Leçon sur l'Isomerie*," p. 123.

** Same *Researches*, pp. 386-388.

On Certain Catalytic Phenomena produced with Glycerine, by Antony Guyard.

Pure glycerine, like most non-volatile organic substances, has on some mineral salts that peculiar but well-known influence which consists in concealing their ordinary chemical reactions with common reagents. Thus, if we mix glycerine and hydrochlorate of sesquioxide of chromium, and if we add to that mixture a little chloride of ammonium and ammonia in excess, the whole will form an emerald green solution, from which sesquioxide of chromium cannot be precipitated; as indeed would be the case with tartaric acid, for instance.

A similar phenomenon is produced with a copper salt, glycerine, and potash or soda, and with a few other metallic salts, either with glycerine and ammonia or with glycerine and potash or soda.

In some cases glycerine and alkalies have no action whatever on metallic salts: sesquioxides of uranium and bismuth remain undissolved in a mixture of glycerine and ammonia, and protoxides of manganese and baryta are precipitated by potash or soda, even in presence of a large excess of glycerine.

Other oxides—those of nickel and cobalt, for instance—are very indifferently affected by glycerine; if this substance is in a large excess, and if potash or soda is added, the whole will form an apparent solution, from which the largest portion of the oxide is precipitated simply by destroying the viscosity of glycerine, even partially, either by warming it or by adding a little excess of water. The other portion of the oxide remains in solution, which acquires various tinges, according to its state of concentration and its temperature. With cobalt, for instance, the colour may be either a splendid blue or a greyish tinge.

With certain metallic salts the deportment of glycerine is extremely remarkable, and constitutes the phenomenon to which I want to call the attention of chemists.

If a large excess of glycerine is mixed with solutions of double sulphate of potash and titanic acid, or with sulphate of alumina, sesquichloride of iron, nitrate of lead, and protochloride of tin; and if ammonia is added, all those oxides will be kept in solution, and will not be precipitated, either by addition of an excess of water or by warming. But if each of these solutions is saturated by hydrochloric acid or by sulphuric acid in sufficient quantity to saturate not only the ammonia present but also the glycerine; though these acids have no rapid chemical action on glycerine, if we realkalify them immediately by an excess of ammonia, the different oxides will be precipitated in presence of the same quantity of glycerine which previously held them in

solution, as if ammonia had simply been added to their respective solutions.

At first this seems strange, for the solutions prepared as aforesaid can be mixed with large excesses of chloride of ammonium already dissolved, and can be warmed and even boiled without showing the slightest trace of precipitation.

A similar and corresponding phenomenon takes place between sesquioxides of uranium and iron, protoxide of iron, oxides of nickel and cobalt, with glycerine and potash or soda. Solutions of a deep colour—yellow for uranium, dark brown for sesquioxide of iron, green for protoxide of iron, blue for cobalt, green for nickel, are obtained; some of which—namely, those of sesquioxide of iron and uranium—can be diluted with excess of water and warmed, and still maintain their oxide in a perfectly soluble state.

If taken as they are obtained at first; if an excess of hydrochloric or sulphuric acid is added, as formerly said, in sufficient quantity to saturate alkali and glycerine; and if immediately afterwards the whole is resaturated by potash or soda, the different oxides will be precipitated as completely as if the alkali had simply been added to their respective solutions.

The key of the phenomenon is here easily found, for if in the alkalino-glycerine solutions mentioned above we add excess, variable for each of them, of chloride of sodium or potassium, the different oxides will be thrown down even in cold solutions. Sesquioxide of chromium itself, which, if the experiment is done in the ordinary manner, seems always soluble, is precipitated from its alkalino-glycerine solution by a very large excess of chloride of sodium.

Evidently, then, these chlorides destroy the viscosity of glycerine and render it fluid, and one of the antagonistic forces being thus destroyed, the oxides obey the other and are precipitated.

In the case of ammonio-glycerine solutions, a similar explanation is true; only chloride of ammonium does not act so energetically. An ammonio-glycerine solution—that of sesquioxide of iron, for instance—can be warmed and boiled with very large excesses of chloride of ammonium without showing any precipitation; but if we aid the fluidifying effect of the salt by adding a large excess of water, sesquioxide of iron is immediately precipitated.

Some interesting phenomena are also produced with certain oxides. Thus from an ammonio-glycerine solution of sulphate of potash and titanic acid, titanic acid cannot be precipitated even if the solution is mixed with a large excess of water and of chloride of ammonium, and boiled; but if a few drops of sulphuric acid are added, the solution remaining strongly ammoniacal, an abundant precipitate of titanic acid is instantly formed.

Alumina presents also an interesting property. If an ammonio-glycerine, or a potash or soda-glycerine solution of alumina, is saturated with an acid, and precipitated by ammonia, alumina, instead of being precipitated in its gelatinous form, will affect the shape of dense flakes, which collect rapidly at the bottom of the flask, and which, if filtered, can be washed with the utmost facility.

This singular property will be found extremely useful in the preparation of hydrated alumina, and the process can be slightly modified for this special purpose in the following manner:—To the solution of the alumina salt, supposed to be pure, an excess of an acid and of glycerine is added; the whole is warmed and then precipitated by ammonia.

At first sight it appears as if the reaction I have enumerated, combined with the well-known action of alkalies on metallic salts, might be usefully employed in quantitative analysis. Unhappily it is not so. I met with practical difficulties, and even impossibilities, at every attempt I made. I will give an example. Let us take a most simple separation—that of alumina and oxide of iron.

Both are soluble in ammonio-glycerine, and in potash or soda-glycerine. Nothing seems more simple than to precipitate iron by a soluble sulphide, filter, and precipitate alumina. Practically we find this—sesquioxide of iron is very soluble in ammonio-glycerine, but alumina, on the contrary, requires an enormous quantity of glycerine to be kept in solution, and the quantity of water we must add to render it manageable is so large, the filtration would be so long, and the quantity of reagents we should have to add to it ultimately would be so great, that it is practically impossible to use it.

If we use potash and soda-glycerine, we find that both oxides are very soluble in moderate quantities of it, that a moderate quantity of water is sufficient for an easy filtration; but if we use sulphide of ammonium, we precipitate not only iron, but the whole of the alumina. If, on the contrary, we use sulphide of sodium, both alumina and iron remain in solution of a very deep green colour, and we may add enormous quantities of water and boil it for a long time without precipitating a trace of iron. We might indeed obtain a perfect saponation by this process if instead of water we were to use methylated spirit or alcohol, for in this case iron is completely precipitated in the state of sulphide, and alumina remains in solution, but the quantity of spirits is too large then to be thought of. We obtain a very interesting catalytic phenomenon, but one unhappily useless.

New Reactions of the Oxide of Tungsten,
by WILLIAM SKEY, *Analyst to the Geological Survey, New Zealand.*

Effects of the Sudden Refrigeration of Tungstic Acid.—If tungstic acid is made red-hot, and then brought in contact with a cold surface, it assumes a black colour, which is permanent in the air.

The change in colour here produced appears to be due to the presence of the oxide of tungsten. The effect of a sudden refrigeration of tungstic acid, therefore, is to deoxidise it.

If the hot acid is dropped into kerosene oil, the same effects follow. The oil, however, may have a reducing power of its own upon tungstic acid at high temperatures; but if dropped into water the tungstic acid sustains no change, the colour of the cooled mass being the same as if it had been cooled slowly in the air. It would seem, therefore, that secondary reactions have obtained in this case, owing to the affinities of the oxygen of the water for the lower oxides of tungsten at elevated temperatures, by which the effects of sudden refrigeration are destroyed.

Solubility of the Blue Oxide of Tungsten in Organic Acids.—If acetic or tartaric acid is added to a hot solution of a salt of tungsten, the blue oxide of tungsten resulting from the deoxidising of the acid by zinc or by the electric current is entirely prevented from precipitating itself, and the solution is coloured thereby of an intensely blue colour.

Solubility of the Binoxide of Tungsten in Concentrated Hydrochloric Acid.—If a perfectly dry salt of tungstic acid is added to concentrated hydro-

chloric acid, a portion of the acid is gradually dissolved, and by the application of zinc the usual phenomena of deoxidisation are manifested; but if every precaution is taken to avoid a rise of temperature, if the zinc is added in small quantities, and the vessel in which the operations are going on surrounded with water, the blue colour will be observed to change to a magnificent purple and then to pink; and by still further continuing the deoxidising process, or by adding a drop of water to the pink solution, its colour is changed to a clear ruby red.

It is necessary to thoroughly dry the vessel to be used before commencement.

TECHNICAL CHEMISTRY.

On the Presence of Propionic and Butyric Acids among the Products of the Destructive Distillation of Wood, by Thomas Anderson, *M.D., F.R.S.E., Professor of Chemistry in the University of Glasgow.*

In the manufacture of sodic acetate from crude pyroligneous acid, a mother liquor is obtained, which, even when highly concentrated, refuses to yield a further crop of crystals. On the addition of sulphuric acid, however, it is found still to contain abundance of acetic acid, having a peculiar rancid smell, which led me to suspect the presence of some of its homologues.

In order to ascertain whether this was the case, a considerable quantity of the mother liquor in question was supersaturated with sulphuric acid and allowed to stand. The crystals of sodic sulphate which deposited having been separated, the fluid was cautiously distilled on a sand-bath, care being taken to stop the process as soon as the slightest trace of sulphurous acid was observed. The distillate was saturated with sodic carbonate, and on evaporation yielded an abundant crop of crystals of sodic acetate. These having been separated, the mother liquor was again concentrated, and this was repeated as long as crystals were obtained. A thick oily fluid was left, to which concentrated sulphuric acid was added in large excess, and the layer which rose to the surface was separated and distilled.

The greater part of it passed over between 117° and 120° C., and obviously consisted of pure acetic acid; but after it had distilled the thermometer gradually rose, and small fractions were collected until it reached 200°, at which point only a small quantity of fluid remained in the retort.

The fraction distilling between 138° and 143° was converted into a silver salt, which was found to contain a quantity of silver intermediate between that of the argentic acetate and propionate. The next higher fraction boiling between 143° and 148° was rectified in a small tube retort, and the latter portion of the distillate having been converted into a sodium salt was fractionally precipitated in three portions with silver nitrate. The last of these was found to contain 59·80 per cent. of silver, and the calculated quantity for argentic propionate is 59·66.

The fraction boiling between 158° and 163° having been treated in a similar manner gave a silver salt which contained 55·10 per cent. of silver, and which was the argentic butyrate, the calculated result for which is 55·30. The acid collected at this temperature had all the characters of butyric acid. It floated on the surface of a small quantity of water, and dissolved in a larger quantity, and its smell was perfectly characteristic.

The acid obtained at a higher temperature had the smell and properties of valerianic acid, but as its quantity was very small, and it was contaminated with a little sulphurous acid, I did not attempt to prepare a silver salt.

I am not aware that these acids have been before observed in crude pyroligneous acid. Their presence in it is not without interest, and is an additional illustration of the frequent occurrence of homologous compounds among the products of destructive distillation.

PHARMACY, TOXICOLOGY, &c.

On the Igniting Point of Petroleum, by* John Attfield, *Ph.D., F.C.S., Director of the Laboratory of the Pharmaceutical Society of Great Britain.*

Crude petroleum generally gives off, at common temperatures, quite enough vapour to form an explosive mixture with the air if it be in a confined space, as in a partially empty lamp, bottle, or cask. For this, among other reasons, crude petroleum is always refined before it is sold to the general public; it is distilled, and the portion which first rises into vapour is collected apart, and, under the name of petroleum-spirit, used as a substitute for turpentine. The next and larger portion which distils is the refined petroleum, so extensively sold under various names as a cheap illuminating oil. The residue is heavy oil used for lubricating purposes.

As petroleum is not a definite chemical compound, but a varying mixture of several hydrocarbons; as, in short, it has no constant chemical or physical property of which advantage might be taken in devising a ready method of taking igniting points, it follows that the method selected must be more or less arbitrary, empirical, conventional. The only feasible plan would seem to be, to select a direct method, simple in principle, easy of execution, occupying little time in performance, and inexpensive; and when this is found, to take steps for accomplishing a far more difficult task—namely, securing its universal adoption. Now the ignition method is sufficiently simple in principle; but I would advise the rejection of its application in an open dish, saucer, basin, or bowl. Even if this experiment could be always similarly performed under constant conditions, which is impossible, the rapidity with which vapour escapes from the surface of the liquid renders a thermometric reading, taken during the experiment, an unfair indication of the temperature at which inflammable vapour would be given off from the petroleum in a lamp or other closed or partially closed vessel. Again, the petroleum must not be heated in a common bottle, on account of the great liability of the latter to fracture; nor is it necessary to use a vessel contrived for violently agitating the oil and air together. But if the bottle be substituted by a short wide tube of glass, thin, so that it can be heated with safety—by, in short, a rather wide variety of the common test-tube of our analytical laboratories—then, if equal quantities of petroleum be operated on, the liquid be fairly well stirred and shaken, and the test-flame be always introduced to the same distance from the surface of the liquid, constant results may be expected. The same tube may be used in which to insert a hydrometer to take the specific gravity of the oil, and thus, with a naked thermometer somewhat longer than the test tube to act also as a stirring-rod, we have a compact and inexpensive apparatus. Halfway up the test-tube should be a mark indicating the

* Abstract of paper read before the Pharmaceutical Society, November 7, 1866.

amount of petroleum to be operated on. The test-flame should be introduced to within half an inch of the surface of the oil.

Into the test-tube of thin glass 6 or 6½ inches long, and 1½ inch in diameter, pour the liquid until the tube is half full. Stir the liquid well with a naked thermometer, having the usual degrees marked on the stem, shaking also so as to keep the upper part of the tube well wetted with the liquid, and note the temperature. Now introduce a flame (of a thin splint of wood, or, far better, a small gas flame a quarter or an eighth of an inch long) into the mouth of the tube to within half an inch of the surface of the liquid, quickly withdrawing it, and noticing whether a thin blue flame runs between the test flame and the surface of the oil. If not, warm the tube by passing the bottom of it gently through a spirit lamp, or other flame, or by dipping the lower portion of the tube into hot water, constantly stirring the liquid with the thermometer, frequently noting the temperature, and introducing the test-flame every minute or so. The temperature at which the thin blue flame appears will be the igniting point of the petroleum, the point at which it gives off inflammable vapour. To correct this result, let the tube gradually cool, introducing the test-flame as before. The lowest temperature at which the vapour takes fire is the true igniting-point.

REPORT ON THE

CHEMICAL LABORATORIES

IN COURSE OF ERECTION IN THE

UNIVERSITIES OF BONN AND BERLIN.

The Chemical Laboratories of the Rhenish Frederick William University of Bonn.

(*Continued from page 246.*)

External Architecture of the Building.

The external aspect of the new laboratories is in perfect keeping with the scale of grandeur of the ground plan.

The street front, shown in Fig. 9, is 180 feet long, and consists of a long centre structure, two stories in height, with richly decorated windows and pillars, terminated by two end blocks of greater height, each containing a main entrance with an ornamented balcony above. The impressive dignity of this front may be realised on beholding even the rough brickwork walls already finished.

The side-front facing the city of Bonn (Fig. 10), with the main entrance for students, has a depth of 250 feet, and consists of two parts, separated from each other by the carriageway leading to the courts. One of these parts is the north-east corner of the front block; the other, perfectly symmetrical in itself, has for its centre the main vestibule with its richly decorated entrance and classically ornamented roof, rising considerably above, and projecting prominently from, the remainder of this façade. On either side of this vestibule branch forth two long wings which, though only one story high, are, nevertheless, of considerable altitude, being relieved, moreover, at the two corners, by slightly projecting portions of somewhat greater height, and marked by the more elaborate architecture of the windows. The impression made on the spectator by this front is exceedingly pleasing, and if the building be viewed from a point where the two façades can be seen (and such from the position of the building will generally be the case), it will be evident how happily the architect has accomplished the difficult task of producing a building, the individual parts of which, though unlike in form, in consequence of the diversity of the objects for which they are destined, are yet so harmoniously blended with one another as not to impair its unity as a work of art.

The two other fronts, of which drawings are not given here, have the same character as that facing the city of Bonn, as may readily be perceived by looking at the ground plan of the building.

The portions of the edifice facing the courts have been disposed and ornamented in a similar manner. A very pleasing effect is here produced by the unequal height of the several parts of the building which separates the front courts. The section along the line C D of the ground plan, which is given in Fig. 6, shows those parts of the court fronts which are not mere reproductions of the exterior façades.

The inner and outer facades are coated with stucco, whilst the principal architectural mouldings are in stone. The entire building will have an uniform tint of colour; only the striæ of the walls of the ground floor will be thrown more prominently into relief by a slight admixture of graphite to the stucco.

Internal Architecture of the Building.

The architectural ornamentation with which it is intended to decorate the interior of the institution will not be less rich than that of the exterior. The principal vestibule, a hall of considerable dimensions, is, as already mentioned, lighted by a band of highly elevated windows running round the four sides of the building immediately underneath the roof. The ceiling is divided into ornamental squares, and the walls are enlivened by projecting pillars bearing carystides, and a rich door architecture which frames the entrance to the corridor. The corridor is divided by pillars and cross-beams into quadrangular sections. The staircase leading to the lecture theatre is a handsomely decorated hall, lighted from above, and communicating with the corridor by three arches resting on two massive columns (see Figs. 5 and 7.)

The lecture theatre, as has been previously remarked, receives its light from both sides through a range of windows, which are separated from one another by columnar pillars. In accordance with this architecture the walls and ceiling are decorated in stucco and colour.

The three laboratories, notwithstanding their necessarily simpler ornamentation, will not fail to make a favourable impression by their liberal proportions, and by the profusion of light which they receive. The walls are enlivened by the numerous windows, and by the tastefully ornamented evaporation niches projecting from the pillars between the windows (see Figs. 5 and 8); nor must the elegant and in all respects suitable fittings remain unmentioned.

The rooms adjoining the laboratories, the small lecture theatre, and the museums, are likewise appropriately decorated by stucco cornices and colouring.

And, lastly, the director's spacious residence is as richly as tastefully ornamented, and will in all respects be worthy of the institution to which it belongs. The Reporter must not enter into details upon this subject, but he cannot leave unnoticed the imposing entrance hall, illuminated by a glass cupola above, and the splendid ball-room, extending through two stories, and amply satisfying the social requirements of a chemical professor of the second half of the nineteenth century.

The author of the preceding sketch has purposely refrained from giving a description of the internal arrangements of the new building. In drawing up the plans of the institution all the interior requirements were of course carefully considered. Especial attention was bestowed on the laying out of a simple and readily accessible system of mains for the convenient supply of water, steam, gas, and sulphuretted hydrogen; on the speedy and safe removal of all by-products, whether solid, liquid, or gaseous, that is to say, on the means of easily and thoroughly cleansing the various departments, on the channels for conducting away waste water, on the flues of every possible kind, for ventilation and carrying off injurious fumes;

and, lastly, on the construction of appropriate niches for evaporation, combustion, and spectrum analysis. All these arrangements are at the present moment only in the first stage of development, and may probably during their execution undergo more or less modification. For this reason the Reporter has preferred to confine himself in this place to a general sketch of the splendid institution which, he believes, will be an ornament to the Rhenish University. A discussion on the interior arrangements is appropriately reserved for a special Report, which cannot be drawn up before they are completed and rigorously tested.

Fig. 9.

Main Façade of the New Laboratories.

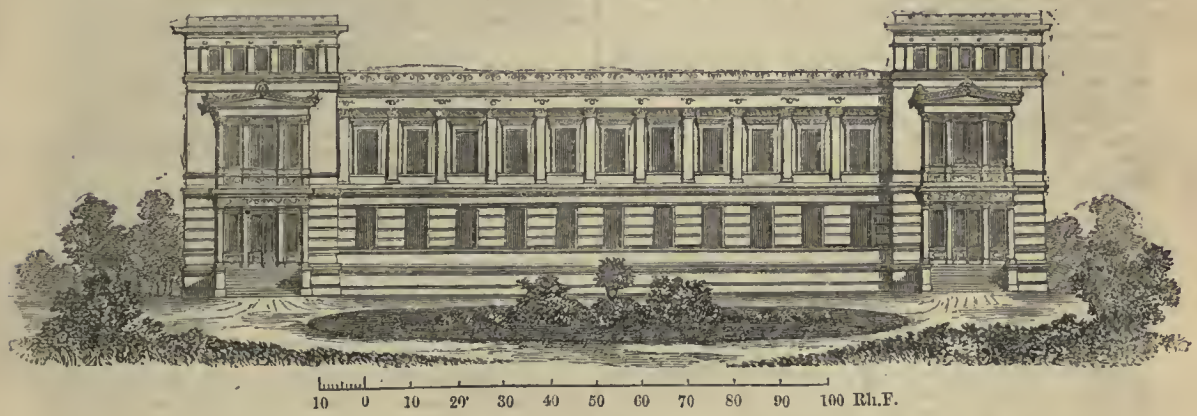

Fig. 10.

Side Façade of the New Laboratories.

(Scale as above.)

(To be continued.)

PROCEEDINGS OF SOCIETIES.

QUEKETT MICROSCOPICAL CLUB.

The monthly meeting was held at University College on the 23rd inst.; Ernest Hart, Esq., President, in the chair.

Mr. M. C. Cooke read a short paper "*On the Best Method of Transmitting Slides by Post.*"

Mr. S. J. McIntire read a paper "*On the Different Kinds of Podurœ*," in which he described their history and habits, how to mount and examine their scales, and his experience in breeding them for microscopical investigation.

Mr. N. E. Green read a paper "*On Melicerta*," being the result of long and careful inquiry into the habits and structure of this minute form of animal life, under high powers and in thin glass cells especially constructed for the purpose.

Nineteen members were elected, and the proceedings terminated with a *conversazione*.

ACADEMY OF SCIENCES.

November 19.

"*On the Shooting Stars of November* 14," by M. Faye. This is a somewhat long account of the observations made by the author on the occasion of the recent meteoric shower. He proposes to give to such observations a character of accuracy which they had not hitherto possessed, by observing with an astronomical instrument, not the shooting stars themselves, but the position of the two extremities of the trajectory which the persistent trains of the largest stars leave on the sky. Two observers and telescopes are required; one to fix the position of each extremity. We do not glean from the paper that M. Faye put this idea into practice. The author points out some facts he has noticed in connexion with periodical meteors: one is, that the planes passing the tangent to the terrestrial orbit, and the points of divergence of the periodical meteors of April 20, August 10, and November 13, are all very nearly perpendicular to the ecliptic. And the same for the meteors of January 2 and 3, whose periodicity has been suspected. But the correspond-

ing planes for the meteors of April 10, October 19, and December 12 are all situated nearly on the ecliptic. It results from this that the meteoric rings of April, August, and November, of which the periodicity cannot be denied, are almost circular, like the terrestrial orbit, or at least that their major axis is very close to the line of nodes—a circumstance which is remarked in many periodical comets. As to the second group, whose annular existence is doubtful, it presents one of the characters proper to sporadic stars. At the conclusion of this paper M. Morin drew attention to a graphic method of determining approximately the geometric form of the trajectories, and even the law of the movement of the luminous projectiles.

"*The Decomposition of Carbonic Acid by Leaves is not in Direct Relation with the Stomata*," by M. P. Duchartre.

"*On the Electric Currents of the Earth*," by M. C. Matteucci.

"*On a Fact in Experimental Therapeutics*," by M. P. Lorain. The author gives a detailed account of a cure which he effected on a cholera patient, so far gone that death seemed imminent, by injecting warm water into his veins. The utterly hopeless state of the patient, who, before the operation, could scarcely be distinguished from a corpse; the ease with which it was performed; the marvellous rapidity with which the worst symptoms were alleviated; and the permanence of the cure; would inspire us with great hopes, were it not that the same plan has been tried with repeated failures in England.

"*On the Shooting Stars of November 13 and 14, 1866*," by M. Coulvier Gravier. The author gives a curve in which the proportion of shooting stars occurring at this time of the year is graphically shown from 1830 to 1866. From this the author concludes that the recent display falls very far short of what was seen in 1833, but he predicts that next year the phenomena will be very much more brilliant, as predicted by Olbers. Unfortunately it will be full moon on the corresponding night next year.

"*Observations made at Metz on the Shooting Stars of November*," by M. C. M. Goulier. These observations presented nothing very striking.

"*On a Meteor seen at Dijon, November 21, 1866*," by M. A. Perrey.

"*On some New Instruments for observing the Organs of Vision*," by M. R. Houdin. The author describes several instruments, which he calls respectively the pupilloscope, the pupillometer, the retinoscope, and the diopsimeter.

"*Remarks on the New Electric Machine, or Continuous Electrophorus recently described by M. Bertesh*," by M. de Parville.

"*On the Disengagement of Gases from their Supersaturated Solutions*," by M. de Gernez. It is known that solid particles in a supersaturated aqueous solution of a gas (soda-water) cause the disengagement of small bubbles. The author has investigated the subject, and has discovered the following facts:—1st. The solid bodies from which the gaseous bubbles are disengaged lose their property after a certain time; 2nd. Prolonged soaking in water also removes this action from them; 3rd. Heat has the same action; 4th. Solid bodies which have not been in contact with air have no action on supersaturated gaseous solutions; 5th. Air and gases provoke the disengagement of dissolved gas. Under each of these heads many experiments are given to prove their correctness. The reading of this paper was followed by a discussion, in which M. Chevreul and M. H. Sainte-Claire Deville took part.

"*Researches on Cyanic Ethers*," by M. H. Gal. The action of hydrochloric acid on cyanic ether results in the simple union of the two bodies, forming

$$C_4H_5O,C_2NO,HCl.$$

This is liquid at the ordinary temperature, colourless, and of a pungent odour. In a small quantity of water it decomposes with evolution of carbonic acid and production of hydrochlorate of ethylamine. The same reaction takes place with hydrobromic acid. The author has also tried the action of the hydracids on M. Cloëz' isomeric cyanic ether obtained by the action of chloride of cyanogen on ethylate of soda; this is non-volatile and insoluble in water, and is totally different from M. Wurtz's cyanic ether. Under the influence of hydrochloric acid, this ether furnishes chloride of ethyl and cyanuric acid. Hydrobromic acid produces a similar decomposition.

NOTICES OF BOOKS.

CHOLERA AND ANTISEPTICS, 1866.

(A) *The Arrest and Prevention of Cholera; being a Guide to the Antiseptic Treatment.* By A. E. Sansom, M.B. Lond. London: Churchill.

(B) *Asiatic Cholera.* By F. A. Burrall, M.D. New York: Wm. Wood and Co. London: Stevens Bros., Covent Garden.

(C) *Reprint from the Appendix to the Third Report of the Cattle Plague Commission.* By Wm. Crookes, F.R.S. London: J. H. Dutton, 1, Wine Office Court, Fleet Street.

(D) *Tenth Annual Report of the Medical Officer of Health for the Holborn District Board of Works, London.*

(E) *Handbills relating to Precautions to be taken against the Cholera.* Various.

The first book of the above list is a summary of the knowledge gained almost exclusively from the late epidemic, and serves to show the steps that have been taken in advance. The whole matter of the volume is of value, and anybody may learn much from it. Dr. Sansom says in the preface that "he hopes that any educated person may be able *thoroughly* to understand the main arguments brought forward," but in justice to him we must say, that a higher knowledge than that of an educated person, in the received sense of the phrase, is required to appreciate many of his views. Much of the matter of the book we must, from want of space, pass over, but would direct attention to the following view of contagion:—The difference between contagion and infection is *practically* of value, although, on theoretical grounds, the distinction is not so apparent.* Thus, three diseases may be taken, all well known—the itch (Type I.), hydrophobia (Type II.), cholera (Type III.). Type I. is a parasitic disease; Type II. is contagious; Type III. is infectious and also contagious-infective, being transmissible by air or water. Our author justly remarks that "a disease may be both contagious and infectious, and altogether we get into a considerable amount of confusion." The remedy proposed is to restrict the term contagious to diseases that have been more accurately called parasitic. But what becomes of Type II.?—we must by this rule call hydrophobia an infectious disease, which disease infects the blood, but is not known to infect by air or water transmittance. The Registrar-General places hydrophobia with glanders and syphilis in Order II. (enthetic diseases) of the zymotic class, thus keeping in view the general broad relations of all contagious and infectious diseases. If we find a disease to be both infectious and contagious, the confusion is not of our, but of nature's making. By taking another standard, we find contagion standing out in still bolder relief from the other two classes—for the poison of parasitic and infectious diseases is organised, that of contagious disease not necessarily so (as generally now admitted). Again, many authors who admit the *de novo* generation of enthetic poison deny a similar generation for organised zymotic virus.

* The usual distinction recognised should be shown clearly for a comprehension of the views of these who use the two expressions as meaning different things. (See note, Cattle Plague Appendix, Reprint, p. 7.)

Dr. Sansom justly lays much stress upon want of good food as a predisposing cause to cholera. We are inclined to place it at the head of the list, and two great facts of the year have not been properly insisted upon in connexion with the late cholera outbreak—we allude to the cattle plague with the consequent rise in the price of meat, and to the monetary crisis with consequent loss of employment; these causes chiefly affected the low Irish population, so many of whom died of cholera, and among whom, on the approach of the harvest and hop-picking season, the mortality was greatly lessened. Of course, they were thus removed from cholera influence, but they probably carried germs of disease with them, with at the same time a greater resisting power.

A Rabbi has attributed the remarkable freedom of the Jews from cholera almost wholly to the goodness of their meat, which by their religion must be wholesome and fresh. Mr. Sala, the popular author, attributes this freedom to quite another cause. "The Jews are great pickle-eaters, and it is very curious that this taste and their well-known penchant for smoking tobacco appear to have operated in a great measure among them as specifics against the frightful scourge of cholera, from which the Jews have hitherto been almost totally exempt." The cholera returns showed conclusively, by the high rate of mortality on Mondays as compared with other days of the week, the effects of alcohol on cholera. In Chapter III. we find a well-deserved tribute to the value of the labours of Dr. Stallard upon the subject of London pauperism—these essays have already an historical value.

Some of the most obvious social evils bearing upon cholera are also discussed, and remedies are proposed. It is remarked that "the low lodging-houses in poor localities contribute largely to the evil of overcrowding." This may be true in one sense, but it should be remembered that these houses are registered and under the surveillance of the police; and this surely is better than nothing at all, for in this case a penalty may easily be incurred, and the licence suspended. Dr. Liddle, the Medical Officer of Health for Whitechapel (who has laboured upon sanitary matters in that district for nearly thirty years, and who is second to none in experience of these matters), has frequently urged upon the Home Secretary the registration of all lodging-letting as the only remedy for overcrowding. In the East of London also a great many families are housed rent free on property belonging to railway companies without windows, water, or closet supply. The neglect in such cases is very culpable, and attention has not been sufficiently drawn to the evil. Our author's remarks on the want of consideration on the part of employers are very well-timed. On the question of pollution of rivers Dr. Sansom observes:—"The time will come, I trust, when the authorities will *prevent the introduction into any river of sewage which has not been previously disinfected.*" And at page 66 we find—"The disinfection of the water of rivers is too herculean a task."

It is also truly observed that "the exact analysis of water should be left to the chemists, whose researches have led to the most valuable results, and who have no doubt been the means, though they have received small thanks for their labours, of saving many lives." It is most desirable "that it should be a universal custom to have a constant supply of a disinfectant to every water-closet and cabinet."

The Registrar-General, in his report for the week ending October 27, 1866, expresses himself strongly on the present state of ignorance as regards disinfectants:—

"The health officers of Bristol and Birkenhead, as well as of London, bear ample testimony to the utility of the disinfection of the cholera dejections by chemical agents. This can only be done effectively under medical supervision. It is a difficult chemical experiment to be performed by an unpractised operator. To place carbolic acid or chloride of zinc, or permanganate of potash, in the hands of people who have never seen these substances, know none of their properties, and have just been terrified by the sudden loss of a father, a mother, or a child, is to do nothing. The poor people cannot be expected to know how a house is to be disinfected, and still less to perform the operation."

Dr. Sansom then discusses in an impartial manner the value of disinfectants, showing clearly that what is wanted is an antiseptic agent, which should be gaseous—not be a mere deodoriser, or yet too much of an odoriser, on which account mainly chloride of lime is objected to; but it also should be noted that spasm of the glottis caused by chlorine may be dangerous if frequently repeated. Dr. Sansom records the following case to the point:—"A patient came to me the other day suffering from sickness and much irritation of the stomach, which she attributed, and I have no doubt rightly, to the excessive amount of chloride of lime which her landlord had caused to be distributed throughout the house."

Sulphurous acid gas is with justice highly spoken of as "an agent of extreme value," with the only objection of being irritant. A great use for it could be found in purifying clothes that are infected, avoiding bleaching, as the author points out—and this doubtless is the field for its future employment, for which purpose carbolic acid might be objected to—but for purifying rooms, &c., we should prefer the latter. Sulphurous acid is summed up as being a deodorant, deoxidiser, and antiseptic. But the preference is given to the tar acids over all others. Carbolic acid, the chief of these, is shown to stop the disease by arrest of fermentation. Carbolic acid is said to "have no chemical action on the bodies with which it comes in contact, nor does it prevent chemical change, but it casts a spell on organic matter, which prevents it from manifesting vital properties," and in support of its use the cattle plague researches are, and we may say have been from the commencement of the epidemic, fully recognised.

In a memorandum† of "a plan of united action in the case of an epidemic of cholera, drawn up by the metropolitan officers of health" this year, the following statements are met with:—"*For the air of the sick chamber*—Sprinkle the floor with chloride of lime;" "ventilating openings of sewers in the middle of the streets, to be protected by *charcoal* boxes;" "areas, yards, &c., &c., to be coated with quicklime and water." "*For the disinfection of the discharges from the body*, a solution of chloride of iron, or chloride of zinc (Sir W. Burnett's fluid), is the most powerful agent, and either should be used in the quantity of about a wineglassful on each occasion. But for the disinfection of the atmosphere of a room, chloride of lime is the best, in the proportion of a teacupful of chloride of lime to a gallon of water, kept in saucers or sprinkled over the room; or the same may be used as a wash to infected bedding and particular parts of the floor, &c. *Disinfection of Clothes.* — This is a most vital matter, not only as regards cholera, but scarlet fever, measles, small-pox, and typhus. No infected clothes ought to be washed at home, or in public or private laundries, *without* preliminary *disinfection*. The best disinfectant is dry heat, at 250° Fahrenheit, where it is possible, for woollen fabrics; linen should be boiled in water, or plunged into boiling water."

In this document it will be noticed that no mention whatever is made of our most valuable disinfectants—viz., carbolic acid and sulphurous acid—perhaps from previously conceived theoretical ideas, to which cause also may be referred the recommendation of charcoal boxes for drains. But as soon as there was an outbreak we find that the majority of Medical officers saw the practical superiority of the tar acids, in proof of which we may refer to their several handbills. Carbolic acid and McDougall's powder are thus specially marked out

† Printed at *Marylebone Mercury* office, North Street, Manchester Square.

by the Medical officers for the parish of St. Mary, Islington. Dr. Gibbon publishes a separate handbill for "the use of carbolic acid and powder" in the Holborn district. Sulphate of iron with carbolic acid are solely recommended for "privies and water-closets" at St. Giles's. Mr. Lionel J. Beale especially recommends carbolic acid for the disinfection of excreta, water-closets, and clothes. In the district of St. Mary, Newington, also, carbolic acid is specially commended for arresting the spread of cholera. This seems sufficient evidence in favour of a new disinfectant, and we rarely meet with such unanimity in favour of an expensive agent or one *theoretically* useful only. But perhaps the most extensive use for carbolic acid has been found in the purification of streets and sewers. Besides its use in London, we learn that it has been used with good effect at many other places. Thus, at Oxford, some drains and sewers were disinfected by means of carbolic acid during last autumn, and the characteristic flavour of carbolic acid was soon afterwards detected in the drinking water, to the great indignation of some householders, who doubtless would have preferred the sewage (if undetected) to the flavour of carbolic acid (so easily detected).

That ozone has no effect on the presence or absence of cholera has been shown by Schultze, Voltolini, Du Methe, Lamont, &c.,‡ but a contrary view is held by some, who think that there is a minimum of it in the atmosphere during cholera epidemics. As regards the charcoal boxes recommended for drains, we learn that charcoal does not seem to disinfect or destroy the cholera poison. The ships which were employed in transporting charcoal from Constantinople to the Crimea were ravaged by cholera.§

We shall conclude our notice of disinfection by enumerating other chemical agents recommended and used in cholera epidemics, and then discuss the later view of the nature of cholera and the rational bearings of the chemical treatment of it.

(To be continued.)

An Elementary Treatise on Heat. By Balfour Stewart, LL.D., F.R.S. Oxford: Clarendon Press. London: Macmillan and Co.

We welcome with pleasure a work on this subject, which has been so long wanted for the higher classes of schools and for students at college. Professor Balfour Stewart, as examiner at two of our modern universities where physical science is directly encouraged, has had ample opportunities of learning the wants of the students of the present day. It would be impertinent to speak of the character of the matter of a work written by so eminent an authority. We may remark that the book is concise, without losing in accuracy or being obscure. All subjects that could be included under the question of heat have been treated more or less fully, with the "latest intelligence" of matters discussed among physicists of the present day. We may cite as instances, remarks on "English and French Systems of Standards," "Anomalies of Cryatallisation," "Atomic Heat," "Forms and Transmutations of Energy," and "Kinetic and Potential Energy." Of great interest is the discussion of perpetual motion and the connexion therewith of the questions of dissipation and conservation of energy. The author, too, seems to think that the question raised by Professor Jevons on the probable future exhaustion of our coal-fields is worthy of discussion, and certainly discourages the sanguine prophecy of Mr. Grove about finding a substitute for our present method of applying force. Throughout the work (as in the first book of this series), theories give way to facts, and the unknown is grouped markedly from the known. Methods of practical application of such groupings of facts are fully explained by general formulæ, and we regret that a series of problems that might be solved by the aid of these, has not been appended to each chapter, with answers. Students can hardly draw up such for themselves, and, as a matter of fact, do not take the trouble; hence their confusion when they meet with such problems for the first time in an examination paper. We hope that some appendix may be brought out to the volume to meet these wants. The necessarily restricted space of the author, has doubtless caused an omission of diagrams, when such could have been introduced with great advantage. With this work, Professor Miller's "Chemical Physics," Professor Tyndall's "Heat as a Mode of Motion" (and we hope soon to add to these the volumes by Sir William Thompson and Professor Tait on "Natural Philosophy," promised for this series), the student of this year will have a better chance of doing credit to himself than formerly he possessed. Professor Stewart is indeed a friend in need to those who require a knowledge of physics, professionally or otherwise.

‡ See Burrall, p. 30. § *Loc. cit.*, p. 60.

A Popular Description of the Small Induction Coil; with a Variety of very Beautiful and Instructive Experiments. By "J. Y. E." Sold at all opticians'.

This is a list of experiments to be performed with induction coils. These little instruments have now become so popular, and may be obtained at so low a price, that this short account of their use is sure to be largely appreciated. The battery recommended is the bichromate of potash or "bottle" battery, which has lately, to a great extent, superseded Grove's for all electrical operations in which considerable power is required for a short time. The description of the coil itself, though short, is clear and intelligible, and the experiments seem to be well selected, the most prominence being given to those with Geissler's tubes.

CONTEMPORARY SCIENTIFIC PRESS.

[Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted.]

Journal de Pharmacie et de Chimie. October.

"*On the Alteration which Tartar-emetic, Metallic Antimony, and its Principal Insoluble Preparations experience in the Animal Economy,*" by M. Bellini.—"*On Coca of Peru,*" by M. A. Fuentes.—"*On Emulsion of Coal-tar,*" by M. Jeannel.—"*Analysis of the Ash of Cress,*" by M. Chatin.—"*New Method of Determining the Amount of Mineral Substances Dissolved in Water,*" by MM. Boutron and F. Boudet.—"*Hygienic Precautions to be taken in Hospitals during Epidemics, and particularly during Cholera,*" extracted from the Report addressed to the Minister of the Interior.—"*Clinical Researches on Bromide of Potassium, and its Employment in the Treatment of Epilepsy,*" by Dr. Voisin.

Annales de Chimie et de Physique. November.

"*Fifth Memoir on the Mechanical Theory of Heat,*" by M. Athanase Dupré (experimental part in conjunction with M. Paul Dupré).

Bulletin de la Société d'Encouragement. No. 163. July.

"*Report on M. Delcuil's Air-pump,*" by H. Tresca.—"*Report on MM. H. Bouilhet and Christofle's Electrotype Processes,*" by Barreswil.—"*Report on M. E. Blot's Terra-cotta Statuettes,*" by A. Barre.—"*Report to the Central Agricultural Committee of Sologne on various Processes for the Preservation of Wine,*" by J. B. Dumas.—"*Report to the Emperor on the Prizes to be offered at the Paris International Exhibition of 1867.*"—"*On the Extraction of Beetroot-sugar by Freezing,*" by A. Reynoso.

NOTICES OF PATENTS.

No. 642. *A New or Improved Chemical Mixture to be used as a Disinfecting and Preserving Fluid for the Cure of Disease among Cattle, and for other purposes.* Victor Larnaudes, Paris. March 3, 1866.

This "new or improved chemical mixture" is :—

Natural water	100 lbs.
Sulphate of zinc	26½ ,,
Sulphate of copper . . .	8 oz.

For the future, it appears, all persons who prepare disinfecting fluids must take care that they do not use the above ingredients, "in or about the proportions" which the inventor may consider to be covered by his patent. We are surprised no one has yet thought of securing a patent for a mixture of hot water, alcohol, and sugar, to be used as an internal antiseptic, "or for other purposes."

Blue and Purple Colours. George Phillips, of Offord Road, Barnsbury. Dated March 10, 1866.

The patentee takes rosaniline or any suitable salt of rosaniline, such as the hydrochlorate or acetate, and mixes it with the acetate or other suitable salt or oxide of the following substances, as lead, copper, zinc, silver, iron, cobalt, strontia, baryta, magnesia, lime, alumina, and to this he adds aniline, and when the whole is well mixed together, he adds acetic, benzoic, or other suitable organic acid, and heats the mass until the desired purple or blue colour is formed. Of the substances above named to be used for the production of colour he prefers lead and baryta, and of the acids to be employed acetic, and he gives the following as an instance of the way to proceed to produce the colours:—Take one part by weight of litharge or protoxide of lead, and two parts of aniline, and mix these well together, and then add sufficient acetic acid to form a thick pasty and nearly solid mass of the two salts formed. To this add one part by weight of rosaniline, or hydrochlorate or acetate of rosaniline, and heat the whole together up to a temperature from 340° to 370°, but not to exceed 400° F., when the colour will be produced. The time required to produce the colour will depend in some measure on the mass to be acted on, but with small quantities about one hour is sufficient, the blue requiring a somewhat longer time than the purple. To purify the mass for a pure blue, when lead is used, dissolve the mass in acetic acid, and dilute with water, and boil until all the lead and red and purple colour are dissolved out and the blue is precipitated. When baryta is used treat the mass with dilute hydrochloric acid, and boil the same until the baryta and red and purple colour are dissolved out, and the blue colour precipitated, which may then be collected, and will be fit for dyeing when dissolved in acetified methylated spirit or other suitable solvent.

The patentee says he is aware that aniline red dye and aniline have been heated together, without admixture of any other substance, to form purple and blue colour, as in Girard's Patent, but the quantity of purple and blue colour thus produced from the same weight of any kind of aniline red dye, say, the acetate and aniline, is very inferior in weight to that produced by the invention herein described, and the difference is so great that a properly conducted experiment with test tubes renders the fact palpable to the eye in a short time.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, F.C.S., Patent Agent, 54, Chancery Lane, W. C.

2558. D. H. Saul and H. P. Armstrong, Islington, Middlesex, "Improvements in means or in apparatus employed in carburetting gas."—Petition recorded Oct. 4, 1866.

2568. W. G. Valentin, Royal College of Chemistry, and G. H. Benson, Stalybridge, Cheshire, "Improvements in the manufacture of steel."—Oct. 5, 1866.

2686. C. A. Girard, Rue des Ecoles, Paris, "Improvements in the manufacture of blue colouring matter." Partly a communication from G. de Laire, Rue de Sèvres, Paris.—Oct. 17, 1866.

2698. W. Simpson, Ilford, Essex, "Improved machinery, apparatus, and processes for preparing and treating vegetable fibres to be used as 'half stuff' in the manufacture of paper, *papier mâché*, and such like materials."—Oct. 18, 1866.

2744. J. Watts, Birmingham, "Improvements in furnaces and fire-places, and in utilising the waste heat of the said furnaces and fire-places, and in utilising and obtaining motive power from the air supplied to furnaces and fire-places."—Oct. 24, 1866.

2791. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the iodide of ethyl, and of other organic iodides." A communication from J. A. Wanklyn, Thann, France.—October 29, 1866.

2641. W. Grüne, Berlin, Prussia, "Developing invisible photographs by the action of ammonia vapours evolved from tobacco, and improvements in cigar tubes or holders and tobacco pipes for holding the said photographs."—October 12, 1866.

2756. H. Phillips, Clyst Honiton, Exeter, "Improvements in the preparation of deodorising materials and in the manufacture of gas."—October 25, 1866.

2768. W. Weldon, Highgate, Middlesex, "An improved method of decomposing chloride of sodium and other compounds by means of steam."—October 26, 1866.

2788. C. McBeath, Blackburn, Linlithgow, N.B., "Improvements in the treatment or distillation of shale, coal, and other bituminous substances, and in the means or apparatus employed therefor."—October 29, 1866.

2851. J. Roberts, Brixton, Surrey, "Improvements in the manufacture of artificial fuel."

2858. F. Claudet, Coleman Street, London, "Improvements in treating waste solutions obtained from burnt cupreous pyrites."—November 3, 1866.

2924. W. E. Newton, Chancery Lane, "Improvements in treating vegetable substances, chiefly applicable to the manufacture of paper pulp and fibres." A communication from B. C. Tilghman, Philadelphia, Penn., U.S.A.—November 9, 1866.

2948. G. Crawshay, Gateshead-on-Tyne, and J. Thomas, Newcastle-on-Tyne, "Improvements in refining pig or cast iron for puddling into wrought or malleable iron."—November 10, 1866.

Invention Protected by the Deposit of a Complete Specification.

2926. H. A. Bonneville, Bayswater, Middlesex, "An improved manure obtained by an improved process of purifying foul waters." A communication from J. Houzeau and E. Devedeix, Boulevard, Sébastopol, Paris. —Petition recorded, November 10, 1866.

Notices to Proceed.

1782. H. G. Fairburn, St. Luke's, Middlesex, "An improved process for forming and combining small coal or coal-dust into lumps, blocks, or otherwise, to be employed for the purposes of fuel."—Petition recorded July 5, 1866.

1789. J. A. Salmon, Liverpool, "Certain improvements in furnaces."—July 6, 1866.

1912. G. T. Bousfield, Brixton, Surrey, "Improvements in the manufacture of certain alkaloids derived from aniline and its homologues, and in their transformation into colouring matters suitable for dyeing and printing." A communication from A. Poirrier and C. Chappat, Rue d'Hautpoville, Paris.—July 23, 1866.

1933. J. Livesey, Park Street, Westminster, "Improvements in refining cast iron." A communication from S. Blair, Pittsburg, Penn., U. S. A.—July 25, 1866.

2658. F. Meyer, and W. Wainwright, jun., Paradise Street, Lambeth, and T. P. Pascoe, Albany Road, Camberwell, "Improvements in the manufacture of candles, and in moulds employed in such manufacture."—October 13, 1866.

2759. G. T. Bousfield, Brixton, Surrey, "Improvements in the manufacture of gases for the purposes of producing heat and the application thereof to metallurgical operations." A communication from W. Elmer, M.D., New York, U. S. A.—October 25, 1866.

2810. G. T. Bousfield, Brixton, Surrey, "Improvements in treating sheet-iron plates for the purpose of preparing the same for being coated with zinc, for producing the so-called 'galvanised iron,' and also for manufacturing such plates in imitation of Russia iron." A communication from C. H. Perkins, Providence, Rhode Island, U. S. A.—October 30, 1866.

CORRESPONDENCE.

Identification of Strychnine.

To the Editor of the Chemical News.

Sir,—The following means of identifying strychnine may prove useful, under certain circumstances, as a corroboration of other tests; I do not think it has been previously noticed. In the examination of animal mixtures for strychnine, it is very difficult to separate that base from traces of organic matter; these may nearly always be recognised in the residue of evaporation from ether or alcohol by their smell, and appear—especially where the latter solvent is used—to interfere with the characteristic crystallisation of that base in tufts of needles, which we find replaced, either wholly or partially, by granules, which to the naked eye appear to be devoid of crystalline character, but, under the microscope, are seen to consist of short and generally very irregular prisms. If a drop of dilute sulphuric acid (one of strong acid to five of water) be now added, the fragments will in a few seconds be observed to swell, assuming at the same time a rounded appearance, and if examined after an hour will be seen to form the centres of tufts of acicular crystals, sometimes of great beauty and regularity, sometimes appearing more like a mass of radiating hairs, retaining the shape of the original crystal, but much increased in size. The fragment is wasted in the process, its residue often appearing as a nucleus for the stellar tuft. The drop of liquid at the same time becomes filled with well-defined stars, formed of radiating needles of smaller size and scattered amongst the greater tufts. If an acid stronger than that described above be used, solution ensues immediately without any of these phenomena. In crystallising pure strychnine from alcohol, especially where the original solution is weak, portions of the base will often take the irregular prismatic form above mentioned, appearing thus upon the sides of the vessel exposed during evaporation.

I am, &c. Thomas P. Blunt.

Manufacture of Iodine.

To the Editor of the Chemical News.

Sir,—I have been a subscriber to the Chemical News for many years. In No. 364 I read an inquiry for the names of manufacturers of iodine. Perhaps it may serve the purpose of your correspondent to know that in this city, where more than nine-tenths of all the iodine produced in Great Britain is manufactured, there are only four works—

	Annual produce.
One producing about	20 kegs of 112 lbs. each
One " "	100 " "
One " "	150 " "
One (my own manufactory)	1000 " "
In all	1270 " "

Should this information be what your correspondent wants, he is welcome to use it. Yours, &c.

William Paterson.

Glasgow, November 26.

MISCELLANEOUS.

Chemical Society.—The next meeting of the Society will be held on Thursday evening, at 8 o'clock, when the following papers will be read:—"*On the Synthesis of Formic Acid*," by Mr. E. T. Chapman; "*On the Alloys of Magnesium*," by Mr. James Parkinson.

Disinfection.—Dr. Gibbon, Medical Officer of Health for the Holborn District, has reported to the local Board of Works that whenever a death or removal of a cholera case has occurred, he has instructed the inspector to retain the key of the sick chamber until every article of bedding and clothing has been plunged into a mixture of boiling water and carbolic acid, and he "considers this method of disinfection more effectual than the somewhat costly one recommended by the Order in Council of burning every article. In order to burn you must generally remove the article, and every removal is attended with more or less risk of spreading the disease."

ANSWERS TO CORRESPONDENTS.

General Index to the First Fourteen Volumes of the Chemical News.—We have had an inquiry for such an index. Its compilation will be attended with considerable trouble and expense; if, however, we find our readers generally wish for one, it shall be commenced as soon as the present volume is completed. Intending subscribers will please notify their wishes to the publisher without delay.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. XIII. of the Chemical News, containing a copious Index, is now ready, price 11s. 6d., by post, 11s. 6d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I., II., and VII. are out of print. All the others are kept in stock. Vol. XIV. commenced on July 6, and will be complete in 26 numbers.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. *Private* letters for the Editor must be so marked.

Dentist.—Dr. C. E. Francis, of the United States, recommends the following dentifrice:—Precipitated chalk, 3 lbs.; powdered borax, ½ lb.; powdered orris-root, ½ lb.; cardamom seeds, 2 ounces; white sugar, 1 lb. Flavour with either ol. rosæ, ol. gaulth., veroli, or jasmine. Colour with rose-pink if desired, leaving out an equivalent quantity of chalk.

Thomas Y.—The specimen enclosed is Spiegeleisen, so called from two German words meaning "mirror iron," or "looking-glass iron," and is so called from its brilliant crystals. It comes from a spathose ore found in Germany, and is a combination of four or five per cent. of metallic manganese with ordinary iron. It is used to give hardness to the soft iron made by the Bessemer process, and adds carbon as well as manganese to the melting.

Manufacture of Soap.—N. B. writes as follows:—"I have been making some soft soap, and find myself fast in the finishing of it, as when I have boiled three or four hours it goes ropy, and cannot get it stiff enough. Will you oblige me so much as to give me instructions how to manage, or prevent it from roping?"

Inquirer asks, "Is there any published account of the methods proposed to be adopted for the utilisation of the sewage of London, or any other large town; and, if so, where is it to be had?" In answer to "Inquirer's" second question, we do not intend to publish the paper at present.

Received.—Dr. Letheby.

Books, &c., Received.—"The Christian Times;" "The Principles and Practice of Photography," by Jabez Hughes; "On Ozone, and its Relations to Animal Charcoal," by T. W. Tobin.

METHYLATED SPIRITS. — DAVID SMITH KIDD, Licensed Maker, Commercial Street, Shoreditch, N.E.
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PATENTS.
MR. VAUGHAN, F.C.S., Memb. Soc. Arts, British, Foreign, and Colonial PATENT AGENT, 54, Chancery Lane, W.C., gives special attention to Inventions connected with CHEMISTRY, METALLURGY, and MINING. Provisional Protection for Six Months, £6 6s. to £8 8s.
A *Guide to Inventors* Free by Post.

PEPSINE and PEPSINE WINE. —M. BOUDAULT begs to state that he cannot be answerable for the purity and strength of any Preparation sold under his name unless obtained from his sole Agent, Mr. PETER SQUIRE, Chemist in Ordinary to the Queen and H.R.H. the Prince of Wales and the Royal Family, 277, Oxford Street, London, to whom all applications respecting it must be addressed.
Third Edition, with Further Remarks by Dr. CORVISART, Physician to the Emperor of the French, edited by W. S. SQUIRE, Ph.D.; published by J. Churchill, London; may be also had of the Author, 277, Oxford Street. Price Sixpence.

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

Preliminary Notice of the Formation and Crystallisation of certain New Ammonio-Salts of the Metals, and the Crystallisation of some of those intensely coloured Compounds which various Organic Substances afford with certain Metallic Oxides in Presence of Caustic Alkalies, by William Skey, *Analyst to the Geological Survey, New Zealand.*

It is well known that many of the double ammonio-salts of several of the metals are easily procurable, and in a crystalline form; but these salts are, as a rule, compounded with the stronger acids. Relatively to the formation of those with the weaker acids, the many blanks in the list of ammonio-salts, given in the late standard works on chemistry, lead me to suppose there is a difficulty.

If such a difficulty exists, it can be greatly lessened by the employment of the method about to be described, and by which I have been able to add rather largely to the number of the ammonio-salts.

The principle of this method is to remove the water from the solution of the ammonio-salt we wish to crystallise, without risking its decomposition by the liberation of its ammonia, as is done when we have recourse to heat.

The removal of the water, or rather the excess of water, is effected by the addition of alcohol in sufficient quantity to these solutions; the affinities of alcohol for water being greater than those which exist between the water and the ammonio-salts, these salts are precipitated.

In all those cases where not expressly stated otherwise, it is sufficient for the purpose to add to a solution of the nitrate or chloride of the metal a little of the acid whose salt we desire, and then ammonia in excess. Alcohol should then be added until a cloudiness appears, which is permanent. The mixture is then allowed to be at rest till the crystals appear; this is generally very shortly after the mixing, but sometimes not for some days. In some cases a liquid precipitate falls; it is then often necessary to repeatedly shake it up with fresh quantities of alcohol.

Copper Salts.

Ammonio-tartrate.—Easily crystallises in short needles of a dark blue colour; permanent in the air, very soluble in water; solution neutral, or nearly so. The ammonio-citrate only precipitates as a liquid, which is not changed by repeated washings in alcohol, and upon evaporation dries up to an uncrystalline hard mass which is very deliquescent.

Ammonio-oxalate.—Crystals granular; colour light blue; decomposed by water into the common oxalate of copper with evolution of ammonia.

Ammonio-phosphate.—Colour light blue; granular; very soluble in water; appears to darken a little before solution.

Ammonio-arseniate.—Like the above in every respect.

Ammonio-borate. — Colour light blue; not very soluble; slowly decomposes in the air.

Ammonio-chromate.—Crystallises in short needles, the colour of which is grass-green; soluble in water without decomposition. If these are redissolved in water, and alcohol again added in small quantity, and the solution suffered to rest for a few days, another kind of ammonio-chromate forms, which is decomposed by water.

Ammonio-sulphite. — From dilute solution forms in well-defined and lustrous needles of a purplish-blue colour, permanent in the air, but slowly decomposed by water; otherwise it is altogether insoluble therein, scarcely affected by cold hydrochloric acid, but readily soluble in ammonia or nitric acid.

Ammonio-cyanide.—Forms in well-defined needle-shaped crystals from dilute solutions; insoluble in water, but slowly decomposed by it; colour dark green; permanent in the air.

Cobalt Salts.

Ammonio-tartrate.—These crystals are of a flesh colour; they are permanent; soluble in water; their colour changes to green when exposed to the air. The ammonio-citrate of cobalt, like the ammonio-citrate of copper, does not crystallise.

Ammonio-oxalate. — Two varieties of this salt appear to form—one of which has a granular form and a red colour; the other salt is in needle-shaped crystals, and has a brown colour, both are decomposed by water, the brown variety changing its colour to green, and evolving gas, probably oxygen; the same changes take place when they are simply exposed to the air.

Ammonio-phosphate.—The colour of these crystals is pink; they are insoluble in water, but are gradually decomposed by it, becoming of a blue colour, which again turns to pink by prolonged exposure, or by contact with water. These pink crystals are also turned of a blue colour by heat, and by contact with caustic potash, the change being apparently due to the loss of ammonia.

Ammonio-arseniate.—These crystals have the same form and colour and exhibit the same reaction as the former salt; they were observed to give off gas (oxygen?) in large quantity when placed in water.

Ammonio-hyposulphite. — Colour light green; soluble in water. To crystallise this salt requires the repeated addition of alcohol.

Ammonio-cyanide.—Appears to separate in granular flesh-coloured crystals, which are almost insoluble in water; also, after the lapse of some days, hard, dark red, semi-spherical masses form upon the sides of the test-tube. These are but slightly soluble in cold water, but much more soluble in hot water, and without decomposition. They are not attacked by cold hydrochloric acid.

Nickel Salts.

Ammonio-tartrate.—Crystallises with difficulty in a granular form; its colour is pale green; it is decomposed by water.

Ammonio-oxalate. — Appears to crystallise in regular octahedrons, the colour of which is dark blue; they are soluble in water without decomposition, and rather deliquescent; when gently heated, they evolve ammonia, and the residue becomes insoluble.

Ammonio-phosphate. — Crystallises in tufts of needle-shaped crystals; scarcely soluble in water without decomposition; their colour is pale green.

Ammonio-chromate.—Colour pale green; scarcely soluble without decomposition; very soluble in ammonia; evolves ammonia when gently heated; exposed to the air, their colour speedily changes to a rusty red, but the crystals remain in form, and still possess considerable lustre.

The corresponding cobalt compound does not appear to crystallise.

Ammonio-hyposulphite.—This compound does not

appear to crystallise; it is deposited as a green-coloured liquid.

Silver Salts.

Ammonio-chromate. — Discovers itself in long rhombohedral crystals of a lustrous yellow colour; they are but partially soluble in water, which easily decomposes them; they are also decomposed by alcohol, unless it is mixed with ammonia; exposed to the air, they rapidly darken, even when kept from the light, and assume the appearance of silver, the form of the crystal remaining perfect, although they are still soluble in ammonia. The ammonio-sulphate crystallised from alcohol in this manner assumes the form of needle-shaped crystals, which, although very alkaline, does not evolve ammonia, even when its aqueous solution is boiled.

Ammonio-phosphate. — Appears to separate in yellow needle-shaped crystals; these may, however, be only the phosphate of silver. As the quantity was so limited, I could not properly test them; indeed, there appears to be some difficulty in the way of obtaining any other ammoniacal salts of silver than the sulphate and chromate by these means.

Ammonio-oxalate.—Crystallises in short rhombs of a brilliant lustre, transparent and colourless; they are immediately decomposed by water. The agents used in this case were oxalate of silver and ammonia. As I could not obtain any result from the use of ammonio-nitrate of silver and oxalate of ammonia, the alcoholic solution was suffered to evaporate spontaneously.

Zinc Salts.

Ammonio-chromate. — Colour of crystals yellow, transparent, rather lustrous; decomposed by water, becoming flocculent, and evolving ammonia in considerable quantity.

Chromium, Iron, Aluminium, and Uranium Salts.

Ammonio-tartrates—With but one exception only, these salts have been crystallised.

The crystals of ammonio-tartrate of protoxide of iron and sesquioxide of chromium are green and needle-shaped; their solution is neutral to test-paper; the iron salt soon turns red by exposure.

The ammonio-tartrate of sesquioxide of iron is pale yellow; its crystals are also needle-shaped, and form in tufts.

Ammonio-tartrate of Alumina.—Is so easily decomposed by washing with alcohol into a gelatinous though very soluble variety of this salt, that to obtain it in well-formed crystals is a matter of difficulty.

Ammonio-citrate of Protoxide of Iron?—By repeatedly washing with alcohol the liquid which precipitates from a solution of protoxide of iron in ammonia and citric acid, to which alcohol has been added, the liquid becomes brown, and finally crystallises in hard granular crystals of a pale brown colour. The iron in these crystals is, however, only partly in the state of the protoxide.

Ammonio-tartrate of Uranium.—Separates in a confusedly crystalline yellow mass. It is best to use the nitrate of uranium as the source of the metal in preference to the chloride. These crystals are deliquescent, and their solution is feebly alkaline.

In regard to the other part of this notice—the crystallisation of some of those intensely coloured compounds which various organic substances afford with metallic oxides in the presence of caustic potash or soda—the following are the salts which I have been able to crystallise, and the method employed is the same as the one already described—namely, by the addition of alcohol to the aqueous solution of these compounds; a short description is given with each.

Potassio-citrate of Copper.—This salt appears to crystallise in two forms, which circumstance may be owing to difference in the proportion which its constituents hold to each other. Those which first appear are needle-shaped and of a pale blue colour, while those which come after are hexagonal, and of a much darker blue, which changes to an indigo blue when long exposed to the air; they are both very alkaline.

Potassio-citrate of Cobalt.—This salt is of a pink colour, and crystallises with facility; it is very alkaline, even after repeated solutions in water and reprecipitation by alcohol.

Potassio-tartrate of Nickel.—Colour pale green; very alkaline; appears to decompose when long exposed to the air.

It is necessary to evaporate the liquid precipitates caused by alcohol, at a very gentle heat, in all these cases, to produce these salts in a crystalline form.

As being somewhat related to the contents of this paper, it may be allowable to notice the following reactions of cobalt.

If ferricyanide of potassium is added to a solution of potasso-tartrate of cobalt, a green coloration is produced, and the addition of alcohol thereto precipitates a green-coloured substance in the form of crystalline flakes.

This crystalline substance is very soluble in water, and it has a very alkaline reaction, of which it cannot be divested by repeated solution in water and reprecipitation by alcohol.

It contains tartaric and ferrocyanic acids, with oxide of cobalt and potash.

As far as I can judge at present, these substances are not mechanically mixed, but are held together by chemical affinity to form a single compound salt, whose distinguishing appellative may be that of the tartro-ferricyanide.

Other precipitates of analogous nature have more lately been produced by substituting a ferrocyanide for the ferricyanide employed; also by substituting a copper, a nickel, or a chromium (sesquioxide) salt for the cobalt salt; and it was found that even the tartaric acid itself might generally be substituted by sugar.

It is proper to mention that the addition of a ferricyanide to a potasso-citrate of cobalt does not change its colour to green.

Since the above was written, a few additional facts have been elicited relative to these salts, which I will briefly notice.

A hyposulphite of copper and ammonia has been obtained of a dark colour by simply warming a solution of ammoniacal copper with hyposulphite of soda. The powder of this salt has a good reddish-purple colour of some permanency; it is insoluble in water, and nearly so in ammonia.

The ammonio-chromate of cadmium is easily obtained by the alcoholic process also; it crystallises in long yellow needle-shaped crystals.

It is only proper to mention that I rest upon the results of qualitative analysis only for my authority in respect to the composition I have assigned to the salts here described; but I propose to submit the more interesting of them to a complete analysis at the first opportunity which presents itself.

TECHNICAL CHEMISTRY.

On the Practice of Disinfection, by Dr.* Letheby, *Health Officer of the City of London.*

I have much pleasure in stating what are the processes of disinfection which I have found most effective in my experience as the Officer of Health for the City of London.

The several disinfectants which I have largely tested are the following :—

1. Chlorine gas.
2. Chloride of lime.
3. Carbolate of lime.
4. Carbolic acid.
5. Chloride of zinc (Sir William Burnett's fluid).
6. Chloride of iron.
7. Permanganate of potash (Condy's liquid).
8. Animal charcoal.

Each of these disinfectants has its own particular value, and may be used on certain occasions in preference to any of the others; thus,

1. *Chlorine gas*, being a very diffusive body, is best suited for the disinfection of places which cannot easily be reached by other disinfectants. I have used it largely for the disinfection of the vaults of churches, where the atmosphere has been so charged with offensive and dangerous organic vapours, let loose from the contents of the decaying coffins, that the workmen could not enter the vaults with safety. In this manner all the vaults of the city churches have been disinfected, and the contents of them put in order and covered with fresh mould. I have found also that chlorine is best suited for the disinfection of rooms where, as is the case with the poor generally, the occupant cannot be removed for a thorough cleansing; and I have employed it with great advantage in places where persons have been sick with fever, scarlet fever, small-pox, and cholera. The process which I adopt is the following :—About a teaspoonful of the black oxide of manganese is put into a teacup, and there is poured over it, little by little, as occasion requires, about half a teacupful of strong muriatic acid (spirit of salt). In this manner the chlorine is gradually evolved, and the action is increased, when necessary, by stirring the mixture, or by putting the teacup upon a hot brick. As chlorine is heavier than atmospheric air, it is best diffused through the room by putting the mixture upon a high shelf. The quantity of chlorine thus diffused should never be sufficient to cause irritation to the lungs of those who occupy the room, and yet it should be sufficient to be distinctly recognisable by its odour. If it be properly managed, the chlorine may be thus diffused through the atmosphere of the room, even during its occupation by the sick.

2. *Chloride of lime* has been very largely used in the city during the recent epidemic of cholera. The inspectors have sprinkled it upon the floors of the houses occupied by the poor, and have scattered it about the cellars and yards. In some cases it has been used with water for washing the paintwork and the floors of rooms. Altogether, indeed, with an average staff of forty-five men, we have used rather more than seven tons of chloride of lime in this manner in disinfecting every week about 2000 of the worst class of houses in the city, and the results have been most satisfactory.

3. *Carbolate of Lime*, which is a mixture, or rather a chemical compound, of carbolic acid and lime, has been used in many cases where the smell of chloride of lime or its bleaching action has been objected to. It has been used by dusting it by means of a dredger over the floors of rooms and cellars; but as the disinfecting power of this substance is destroyed by chloride of lime, it is of great importance that they should not be used together. The carbolate of lime which we have employed contains 20 per cent. of carbolic acid; it is essential that this should be its minimum strength, or its power is not sufficiently efficacious. The strength of it may be ascertained by treating 100 grains of it with sufficient muriatic acid, diluted with its own bulk of water, to dissolve the lime, when the carbolic acid is set free, and floats upon the liquid; this, when collected, should weigh twenty grains at least. The advantage of carbolate of lime is its continuous action, for the carbonic acid of the air slowly lets loose the carbolic acid, which diffuses itself through the atmosphere in sufficient quantity to act as a disinfectant, and it does not destroy the colour of clothing.

4. *Carbolic acid* has been used as the sole agent of disinfection for privies, drains, and sinks, and for the sewers and the public roads. In the former case it has been used in its concentrated state by pouring it at once into the privy or drain, but in the latter case it has been diluted with about 2000 times its bulk of water, and sprinkled by means of the water carts upon the public way. In this manner about 1000 gallons of carbolic acid have been used in the City thoroughfares; and the acid getting into the sewers, we have observed that the usual decomposition of sewage has been arrested, and instead of a putrefactive change with the evolution of very offensive gases, the sewers have been charged to a slight extent with carbonic acid and marsh gas. As there are many coal tar acids now sold for carbolic acid, it is of importance that the adulteration should be recognised. This may be done by observing the strength of the soda solution which will dissolve the tar acid. All the inferior acids are insoluble in a weak solution of caustic soda.

5. *Chloride of Zinc*, Sir William Burnett's fluid, or, as it is sometimes called, Drew's disinfectant, is well suited for the disinfection of the discharges from sick persons, but it is hardly applicable to any other purpose. The liquid should be of a proper strength, as having a specific gravity of 1594, water being 1000; and it should contain about from 50 to 54 per cent. of solid chloride of zinc. A tablespoonful of this liquid is sufficient to disinfect each discharge from the body.

6. *Chloride of iron* is applicable in exactly the same manner as chloride of zinc, and is only suited for the disinfection of the discharges from the body. It should have a specific gravity of 1470, and should contain about 40 per cent. of metallic chloride.

7. *Permanganate of Potash* is only suited for the disinfection of drinking water; for not being a volatile disinfectant, and being very slow in its action, and requiring much of it for any practical purpose, it is not available as a common disinfectant; besides which it attacks all kinds of organic matter, and will therefore destroy clothing and be neutralised by every species of organic substance. As a disinfectant of water, however, in localities where good filters of animal charcoal cannot be obtained, it may be usefully employed to disinfect water by adding it thereto until the water retains a very pale but decidedly pink tint. The permanganate which is sold, generally has a specific gravity of 1055, and contains about 6 per cent. of permanganate of potash. It will take more than a pint of this liquid to disinfect a pint of the rice-water discharge from a cholera patient, and even then the disinfection is very uncertain.

* Observations communicated to the Registrar-General.

8. *Animal Charcoal.*—I may state that for the disinfection of water and the removal of dangerous organic impurity, I have ascertained by experiment that the best treatment is first to filter the water through animal charcoal, and then to boil it for a few minutes. It may then be safely drunk.

The disinfection of bedding and all articles of clothing is best effected by exposing them in an oven to a heat of from 260° to 300° Fahrenheit. The exposure should be sufficiently long to insure the thorough heating of every part of the material to that temperature. When such a process cannot be used, the clothing should be put into boiling water, and kept there until the water cools to the common temperature.

I refrain from entering into any explanation of the mode of action of these several disinfectants; for whether the agent of disease is a living germ, capable of reproducing itself in the human body under certain conditions, as most likely it is, or whether it is an unorganised, or even, as Dr. Richardson supposes, a crystalline compound, the practical results are the same, and are unquestionable; and, in conclusion, I would say, by way of summary, that for the disinfection of sick rooms chlorine and chloride of lime are the best agents; for the disinfection of drains, middens, and sewers, carbolate of lime and carbolic acid are the best; for the discharges from the body, carbolic acid, chloride of zinc, or chloride of iron are the best; for clothing, the best disinfectant is heat, above 260° if a dry heat, and 212° if a wet heat; and for drinking water, filtration through animal charcoal and a boiling temperature.

I may mention that the best disinfectant for stables and slaughter-houses is that prepared by Lewis, Ash, and Co., at Bow. It is a mixed chloride and hypochlorite of zinc, and it has the advantage of mixing freely with the liquid matters of the slaughter-house, and not tainting the meat with any unpleasant odours. We have used it very largely for this purpose, and it is also applicable to the disinfection of houses in place of chloride of lime, which it much resembles in its chemical nature and mode of action.

College Laboratory, London Hospital.

PHARMACY, TOXICOLOGY, &c.

Analysis of Eland's Boontjes; a Species of Acacia yielding Food, Medicine, and Tan to the Natives of South Africa, by* John Attfield, *Ph.D., F.C.S., Director of the Laboratory of the Pharmaceutical Society of Great Britain.*

This is the local name of a plant in the Orange Free State, South Africa, derived from a Dutch word, and signifies the "little beans" eaten by Elands. From the bean the Kaffirs extract, by boiling, an oil which they use in food; an infusion of the root is employed by them as a gargle, and is taken in cases of dysentery and other affections of the bowels; while both the natives and the Dutch Boers find the root of considerable value in converting skin into leather, the Boers using it as a substitute for oak bark in tanning, and the natives employing it in the preparation of their "karosses," or blankets, by rubbing it on the flesh side of the skins of animals. The root being of considerable value as a tanning agent, it became a matter of some interest to determine the amount of tannic acid it might contain. On making experiments with this view, 13 per cent. of tannic acid was obtained as the mean of six experiments.

The beans are, in the dry state, externally of a dark chestnut colour, and about twice the size of a horse bean. On opening them, a yellowish-white kernel is seen, weighing about two-thirds of the weight of the whole seed. A given quantity of the kernel was digested in ether in the usual way, to dissolve out the oil, 34·6 per cent. of which was obtained, or 22·5 per cent. reckoned on the whole seed. The oil is of light colour, not very fluid, inodorous, and has no marked flavour.

The percentage of nitrogen in the kernel is 3·6, in the integument 1·03. This nitrogen probably all exists in the state of vegetable albumen. If so, the percentage of albumen in the kernel is 22·6, and in the integument 6·48. Or, as an average of the weights of kernel and integument of several seeds gives the weight of the kernel as 1·099 grammes, and its accompanying integument ·594 gramme, it follows that the average amount of albumen in the whole seed is nearly 17 per cent.; about three-fourths of the proportion commonly existing in peas, beans, and other leguminous seeds.

The percentage of ash in the kernel of the seed is 1·82, in the integument 1·54, or in the whole seed 1·72.

Thus, in 100 parts of the seeds or beans we have—

Albuminous matter (legumin)	17·0
Oil	22·5
Woody fibre, moisture, etc.	58·8
Ash	1·7

And in 100 parts of the root—

Tannic acid	13

* Abstract of paper read before the Pharmaceutical Society, November 7, 1866

REPORT ON THE

CHEMICAL LABORATORIES

IN COURSE OF ERECTION IN THE

UNIVERSITIES OF BONN AND BERLIN.

The Chemical Laboratories of the Rhenish Frederick William University of Bonn.

(*Continued from page* 259.)

Appendix to the Report on the Chemical Laboratories in Course of Erection in the University of Bonn.

But few months have elapsed since the foregoing report was written. Events, however, that at other periods would have required a lifetime for their consummation, have thronged together in this brief span of time. A fierce war has broken over Germany, dividing its races into two hostile camps. The flower of the nation is still under arms, and the Prussian eagles in their victorious flight have traversed all Germany. At such an epoch, it might be thought, the arts of peace could move but slowly. *Inter arma silent Musæ.* So perfect, however, is the order which regulates the several departments of the Prussian Government that the great works of the Minister of Public Instruction for educational purposes have suffered scarcely any interruption. The building of the Bonn Laboratory, in fact, has, notwithstanding the exigencies of war, made considerable progress, and various appliances, which were mentioned in the preceding description as in project, or as existing only in their merest rudiments, have since attained completion. It seemed of interest to append to the report a brief sketch of some of these arrangements.

Evaporation Niches.

In a great number of chemical operations vapours detrimental to health are evolved, which should be removed as quickly as possible from the working rooms. To effect this, every laboratory is provided with a few large places

Ventilated by chimneys, in which such work is to be conducted. But they seldom fulfil their object in a satisfactory manner. In many cases the amount of gas disengaged in a given experiment is so small that the student thinks it scarcely worth while to leave his working bench in order to conduct the operation under a chimney. The evolution of vapours, however, recurs very often, and must, particularly in a laboratory where a great number of operators are at work, ultimately contaminate the air so as to render ordinary ventilation totally insufficient. This especially occurs during the repeated evaporation of acids and ammoniacal salts in mineral analysis.

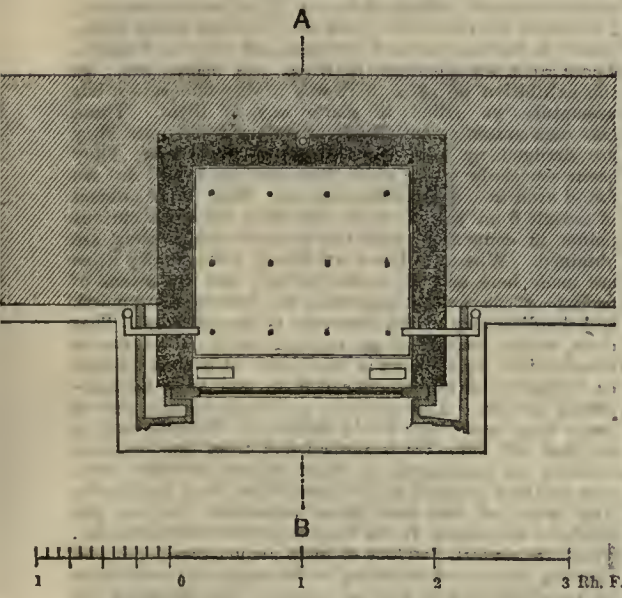
To remedy this inconvenience in the case of the Bonn Laboratories, there have been constructed, instead of one or two larger evaporation niches, a considerable number of smaller ones distributed over the entire space so as to enable the manipulator to perform such operations almost without leaving his working-bench.

For this purpose nearly all the window pillars are provided with niches. Their disposition in the three main laboratories (C, D, and E), as well as in the director's private laboratory (Z), becomes apparent by a glance at Fig. 2, page 211, and Fig. 5, page 244.

The essential conditions which an arrangement of this kind should satisfy are the following:—

1. Speedy and certain withdrawal of obnoxious gases.
2. Supply of air to support combustion.
3. Protection of the liquids to be evaporated from condensation products deposited in the flue.
4. Continuous removal of these condensation products, and of liquids that may be spilt in the niche, &c.

Fig. 11.
Evaporation Niche.
Horizontal Section along the Line C D in Vertical Section.



That in the construction of these niches no materials are to be employed which would be acted upon by such vapours, scarcely requires a special mention.

It has been attempted to supply these wants in the following manner:—The niches are ranged along the outer walls of the building, in the spaces between the windows; they project somewhat from the inner face of the wall, in no case, however, so far as to impede the passage round the working benches facing the window recesses. Each niche consists of an open space having an area twenty inches square and a height of twenty-six inches—dimensions generally sufficient for the reception of the apparatus here to be employed. The bench of the niche is three feet two inches above the floor of the laboratory—an elevation selected for all tables, window-sills, niches, &c. The base, the sides, the back, and the roof of the niche are made of compact sandstone; the opening in front is closed by a pane of plate glass which can be adjusted in any position by means of counterpoises acting over pulleys.

Fig. 12.
Evaporation Niche.
Vertical Section along the Line A B in Horizontal Sections.

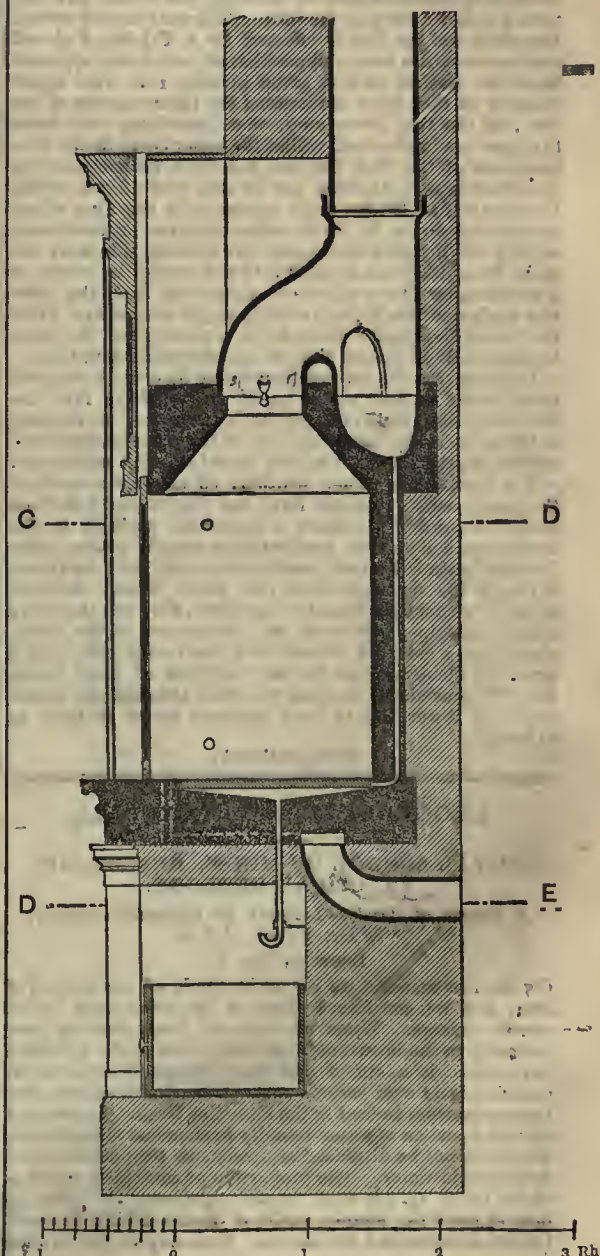


Fig. 11 shows the ground plan of the niche above the level of the working bench.

For the removal of vapours the funnel-shaped roof communicates with an earthenware pipe, seven inches in internal diameter, rising within the wall to a height of twenty-one and a half feet from the floor. A gas flame burns in the funnel to promote the draught. The gas issues from a steatite burner, which is cemented into a porcelain pipe entering from the side, and by this means the employment of metal, which would be rapidly corroded, is entirely avoided. The gas pipe, on account of its fragility, is so placed that it can be easily renewed.

To protect the liquids evaporating in the niches as much as possible from any dirt that may fall down the flue, the latter is not situated directly over the gas flame, but lies nearly a foot deeper in the wall. The connexion between the niche and the flue is effected by a Y-joint of glazed earthenware, the form and position of which are apparent from the vertical section given in Fig. 12. The upper opening of this joint is intended for the reception of the flue; of the two lower ones, that branching out closes the aperture in the roof, whilst the other lying in the prolongation of the flue fits into a second funnel pointing downwards and likewise set in the roof of the niche. Here collect all the products deposited in the flue, which are washed down its walls either by rain or condensed water; the liquid which comes down on the side next the niche being likewise directed into the funnel by means of a semicircular sharp-edged rim projecting from the interior surface of the Y-joint near its upper extremity. From the funnel the products run down to the base of the niche through a small leaden pipe let into the wall behind it.

In order that the second funnel may be readily cleansed from foreign matters which accidentally falling into the flue cannot be carried off by the leaden pipe, an opening is left at an easily accessible part of the joint immediately over the funnel, which is merely closed by brick and mortar.

The base of the niche, whither, as already remarked, the condensation products flow, has the form of a shallow basin. In order to insure a horizontal position to the apparatus, a slate slab, perforated in several places, overlies this basin. Liquids accidentally spilt may be rinsed through the openings into the basin below, whence, together with the condensation products, they run through a small lead pipe, cemented into the centre of the basin, down into a movable wooden box lined with lead, which serves at the same time for the reception of used filters, &c. To prevent air entering the niche through the waste-pipe, its lower end is bent upwards so as to form an air-trap.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

ROYAL SCHOOL OF MINES, MUSEUM OF PRACTICAL GEOLOGY.

A Course of Twelve Lectures on Chemical Geology, by Dr. Percy, F.R.S.

Lecture No. XI.

On the last occasion we began the study of the subject of iron, and we considered some of its compounds which occur in nature. When we broke off, I was drawing your attention to the brown oxide of iron; that is, the hydrated peroxide of iron, one of our most important ores, which occurs largely over various parts of the world, and in very large quantities indeed in the Forest of Dean. It contains always a portion of water actually in chemical combination, which cannot be displaced at a very low temperature like hygroscopic water. The proportion of combined water is about 12 or 14 per cent. in the pure ore. It is well to bear in mind the simple mode of distinguishing between the red iron ore and the brown. You may do this at once by means of the streak. The practice with metallurgists is to take a piece of unglazed pottery and just draw the ore across it. You will find with regard to the red ore, however bright or metallic its lustre, that the streak it makes will uniformly be red, while that of the other ore will uniformly be brown. A very large quantity of the brown iron ore, to which the French apply the term limonite, has been found in different parts of England in recent times, or perhaps I might more correctly say rediscovered. The so-called Staffordshire ore, which is found in large quantity, is nothing more than the impure brown hæmatite earth in balls, perfectly non-crystalline, and containing impurities—chiefly sand and phosphoric acid. The phosphoric acid is an impurity in these ores, sometimes of very great consequence indeed. It affects in a most material degree the value of the iron obtained from them, and I am sorry to state that in Northamptonshire ores there is a great variation in respect to the quantity of phosphoric acid. Sometimes we find a very small quantity, not more than occurs in our clay iron ores, and at other times there is a very large amount—2, 3, or 4 per cent., or more. That is a point of very serious consequence. We have also these ores occurring also in Lincolnshire and other parts of England. They occur in the oolite and in the lias, principally in the oolite, and are chiefly derived from the weathering action, on a pre-existing carbonate. We have found many specimens from time to time which show the transition perfectly from carbonate to brown oxide. I pointed out to you a specimen found at Hastings, where you will find an abundance of them, showing how carbonate of iron is, by the joint action of air and moisture, superficially converted into brown oxide of iron. The carbonic acid slowly escapes, while the first oxide of iron with which it existed in combination is *pari passu* oxidised and converted into brown oxide.

There is one class of these ores which yet remains to be considered, and perhaps it is one of the most interesting. I allude to the so-called "lake ores," which occur abundantly in certain parts of Sweden, and also in Finland. There are a few specimens of these ores before you. In the exhibition of 1862 there was a very fine series, but unhappily we failed to secure any of them. These lake ores consist essentially of brown oxide of iron. They are dredged up from the bottoms of the lakes. They occur especially where rivers flow into the lakes, and are found even to a considerable extent. They are the object of search from year to year, and there are some curious points in connexion with the mode in which they are obtained. When the lakes are frozen over, sundry holes are made here and there in the ice, and by means of probes or convenient apparatus the bottom is sounded, and the discovery of the lake ores is thus effected. That done, certain boundaries are marked out in the ice, and at a convenient time the ore is taken out. It is then washed, or "jigged," as the miners call it, to take away the associated matter. The quantity produced in one year is larger than many here would suppose. What is curious is, that this lake ore is replenished from time to time. Even in the same spot, in about twenty or thirty years, you will find as much as you have taken away previously. The origin of this lake ore is somewhat curious and doubtful at present. It has been supposed to be infusorial. There are several varieties of form among these ores, and they are designated according to the supposed resemblance of their particles to familiar objects. For instance, we have "gunpowder ore," which is granular and in small pieces. Then there is "money ore," which is in small masses resembling coin. There is also "cake ore," which has received its name from another resemblance. In looking over some of the smaller ore—the gunpowder ore, for example—it may possibly furnish a clue to the structure of the Cleveland ores, which are highly oolitic—so called from a Greek word on account of its resemblance to the roe of a fish. Let us suppose that a quantity of this gun-

powder ore has become diffused through earthy matter and that then, by some cementing matter, the whole mass has become firmly cemented or agglomerated, I think we should get a mass of matter like our Cleveland iron ore. I only throw this out vaguely as a hint. I do not say it is satisfactorily proved. One would have supposed that these lake ores would have contained a large amount of phosphoric acid. Well, they are not deficient in it; far from it; but still they do not contain as much as might be expected. These lake ores are used as a source of iron in Sweden and Russia for certain special purposes.

There is another variety of ore called bog ore, which is met with in bogs and swampy places. It appears to be infusorial, and is generally rich in phosphoric acid. The effect of phosphoric acid is to produce an iron excessively brittle when cold, but well adapted for casting, being very fusible.

There is one point I should not omit in connexion with this part of our subject. It may be useful to gentlemen who are curious in searching for iron ore, and many are so engaged in various parts of England—many profitably engaged. Never attempt to judge of the value of iron ore from its weight. Here is a light spongy piece of ore, apparently worthless. It is a piece I got out of a large vein at Alston some years ago. Well, light and spongy as that appears, it, nevertheless, contains about 46 per cent. of pure iron, which is a large proportion, and besides that about 11 per cent. of manganese. I have known many persons misled by considerations as to the weight of the specimen. The specific gravity of an iron ore is no test of its value.

We have spoken now of protoxide of iron and of red iron ore or red oxide of iron, and of the combination of that oxide with water under the name of brown iron ore. The next oxide is one of vast importance—at all events in a chemical point of view, and apparently in geological respects—namely, the magnetic oxide of iron. It is a curious thing that that oxide which approaches nearest to iron in constitution, containing more iron than the other oxides, is not at all magnetic—namely, the protoxide of iron. Then we come to the peroxide of iron, or sesquioxide as it is commonly called, to use the old notation. We will suppose one equivalent of protoxide combined with one of sesquioxide, and we get magnetic oxide of iron. I may state that recently it has been found that red oxide of iron, when prepared in a particular way, is highly magnetic, like the magnetic oxide. Long ago it was observed by Rose that certain specimens of peroxide of iron occurring naturally had a magnetic property; and I may state that I experimented some years ago upon specimens obtained from Cumberland, and found that they did to a small extent, but appreciably, affect the magnetic needle.

Magnetic oxide of iron may be easily formed artificially. It occurs in nature splendidly crystallised in the regular cubical system. It can also be obtained artificially crystallised. When the peroxide of iron is exposed to a high temperature alone, without the action of any reducing agent, contrary to what some people suppose, it is decomposed and reduced to magnetic oxide. It loses a portion of its oxygen, and becomes magnetic oxide. That is a point which you should bear in mind. We frequently find this magnetic oxide as a product in metallurgical operations, and sometimes beautifully crystallised. I may refer you to specimens in the case above, some of which are the finest ever discovered, I have no doubt. There are large clusters of crystals obtained in various processes in our iron and copper furnaces, and elsewhere. They are always in the form of the octahedron—sometimes clearly defined, and at other times these octahedra are grouped curiously into one another. Once I found the crystals in a specimen from South Wales in the form of the rhombic dodecahedron. That specimen is a most beautiful thing, and though I have been searching for these things for many years, I have only found the mineral once in that form when artificially produced. Those of you who are acquainted with the mineral from Traversella will, I think, recognise the very close resemblance between this artificial product and that naturally occurring at Traversella.

Magnetic oxide of iron occurs not only crystallised but amorphous. We can easily produce it in that state. There is a specimen of it in this vessel before you. We have only to take the two salts, protochloride of iron and perchloride of iron, and mix them together in such a proportion that when we put in a substance to abstract the acid what is left will be this substance. It is a very stable compound—much more so than might at first be supposed. It is not liable to become further oxidised. Here is some of this magnetic oxide prepared a long time ago in the manner described, collected upon a filter, and then washed and dried with free exposure to the air. You see it has not become converted into peroxide of iron. If it had, the oxide so formed would not have had the least magnetic property, but you see how magnetic this specimen is. It is the amorphous magnetic oxide of iron. We have lately found some amorphous magnetic oxide of iron, an iron ore of considerable importance. When common sand and even red oxide of iron are strongly heated together, they combine and form silicate of protoxide of iron, a very fusible compound, which may be frequently obtained artificially even in small crucibles, sometimes most beautifully crystallised. It is easily formed. Well, take such a silicate of iron, and heat it with common lime; that lime displaces the iron from its combination with the silica, forming silicate of lime, and you get the magnetic oxide of iron beautifully crystallised. For this experiment we are indebted to the late Professor Ebelmen, who had the direction of the porcelain works at Sevres. It may also be formed by heating chloride of calcium with sulphate of protoxide of iron—that is, common green copperas. This has to be performed in a covered crucible. Kuhlmann made it crystallised in that way. It may also be produced by the action of the vapour of fluoride of iron on molten boracic acid. Mitscherlich formed it in this manner. There is one observation which appears to be important in mineralogical operations. I allude to a statement made by Becquerel. He tells us that he found on a bar from the foundation of an old castle, which had been some time under water, three layers of oxides. The outermost layer consisted of hydrated sesquioxide of iron, the second of anhydrous or red oxide, and the third, or innermost, of magnetic oxide. The layers of red and magnetic oxide were distinctly crystallised.

When metallic iron undergoes oxidation under water, or in contact with gravelly matter, it has a marvellous power of agglomerating the particles together, and consolidating them into a most firm and substantial lump. I had specimens illustrating this on a former occasion. You may see this at almost any seacoast place where those iron drain-pipes happen to be stretching themselves along the shore. You see there various kinds of shells most firmly adherent, and sometimes pebbles. So firmly are they agglutinated, that I have tried vainly to knock them off with a hammer. Then, again, I have seen an iron instrument taken out of the bed of a river, with an accumulation of gravel round it as big as a man's head, and the mass was not friable, but hard. It is quite possible that engineers might make a practical application of this cementing power of iron. No doubt some thousands of tons of fragments of iron thrown down pell-mell against the foundation of a structure—in making an embankment, to wit—would in time greatly add to the consolidation of the whole.

Now as to the mode of occurrence of magnetic oxide of iron in nature. First I will take the amorphous variety, which we have met with of late in Yorkshire—specially at Rosedale, in that county. The mineral there found is in carbonate of lime really, and it contains silicate

of iron. You may properly put the question to me, "What right have you to call this magnetic oxide of iron?" Well, perhaps I have no very good right: at all events, I cannot offer you a certain and conclusive proof of the fact. Here is an iron ore which is magnetic, which is amorphous, and which, I think, there is some reason to suppose does contain the iron in the state of magnetic oxide, and it is also polar. I do not know whether magnetic oxide of iron occurs in any other locality in England. In nature it occurs massive, sometimes in magnificent crystals and in very large quantity indeed. I might take you to beds of it twenty, thirty, fifty, or a hundred feet in thickness in Canada; and in Gellivard, in Lapland, there is almost a mountain of it, and a very beautiful mountain it is. I believe attempts are being made to construct railways there, and render this mineral accessible to our markets. Then we have it at Arendal, in Norway, in several parts of Sweden, and in the Ural. It is, in fact, one of the ores of Sweden. There are two principal ores used in Sweden—the red oxide and the magnetic oxide. They also use the lake ores, but only for inferior purposes, such as casting. With reference to its abundance in Canada, Sir William Logan has given statements which seem almost incredible. At Arendal it occurs in granite, and in the well-known so-called metamorphic rock, gneiss, and also with garnet. It is interesting to note this association of it. It is also found in serpentine in connexion with garnet, augite, and hornblende, in Bohemia. It occurs in association with greenatone, granular limestone, garnet, hornblende, augite, and quartz, with augitic porphyry at Blagsdal, in the Ural; and in druay cavities filled with crystals both of magnetic oxide of iron and iron pyrites. The association of iron pyrites and magnetic oxide is important, as it may tend to furnish us with some clue to the formation of the magnetic oxide. It occurs also with calcspar and analcime. In Thuringia it is found in hypersthene rock with crystallised carbonate of iron. Then it has been found also in association with dolomite in Canada. Sir William Logan has told us of its association in the very substance of the rock. It is also found in basalt, as at Taberg. The magnetic quality of certain basalts is supposed to be due to the association of this magnetic oxide of iron, it being diffused through their mass. I called your attention in the last lecture to a statement made by Professor Andrews, of Belfast, that the basalts which manifest a magnetic character contain metallic iron diffused through them, but I do not think he has clearly established the fact, though he got a precipitate of metallic copper when the rock was immersed in a solution of sulphate of copper. I think it would be easy to account for the deposition of the copper, supposing the iron did not exist in the metallic state in the rock. Magnetic oxide of iron occurs also in lava at Monte Somma, in several sedimentary rocks, and in clay slates in France.

There appears to be no doubt that proofs exist, though their number is limited, that magnetic oxide of iron has been the result of sedimentary deposition. It has a character in which sedimentary origin appears to be plainly indicated, but with regard to the way in which these masses of oxide of iron have been produced opinion is by no means decided at present. It is a very difficult subject, and one richly deserving close and continued attention. No doubt ultimately we shall know vastly more of these interesting points concerning chemical geology than we do at present. It has been conjectured by some persons that there are cases in which the magnetic oxide of iron has actually been molten and poured into crevices and into fissures, and so formed; but I think, upon the whole, when we survey the general mode of the occurrence of this important and remarkable mineral in the world, we shall say that it is, perhaps, the result to a great extent of the so-called metamorphic action, which we have reserved for future consideration. But the plain long and short of it is this—that we know very little about it of a satisfactory kind—about the chemistry of it, at all events. I would especially ask those gentlemen who may have an opportunity of examining these rocks hereafter to note particularly the associates of the rocks, and the materials which may exist in the magnetic oxide of iron itself. Now, I will give you an instance of the importance of such observation. In certain cases, there is no doubt, free silica is present. We know that if magnetic oxide of iron is brought in contact with silica at not a very high temperature, combination takes place, and silicate of protoxide of iron is formed. Now, it is impossible to assert, supposing we admit the contemporaneous presence of these two things—the silica and the magnetic oxide of iron—that they could have been exposed, in conjunction, to a high degree of heat. Thus, a small fragment of silica, occurring in a free state in a rock of this kind, may furnish us with strong evidence of the precise conditions under which the rock has been formed, or rather, the conditions with regard to temperature under which it has *not* been formed.

(To be continued.)

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, October 30, 1866.

R. Angus Smith, *Ph.D., F.R.S., &c., Vice-President, in the Chair.*

Professor R. B. Clifton, M.A., F.R.A.S., late of Owen's College, but now of Oxford, was unanimously elected an honorary member of the Society.

"*On the Manufacture of Sulphide of Ammonium,*" by Peter Spence F.S.A., F.C.S.

Hydrosulphuret of ammonia, or sulphide of ammonium, is at present chiefly used in the laboratory, where it is a very useful reagent in metallic and other analyses, and it has often been thought it might be more extensively used if it could be made cheaply and of good quality. At present it is made by directly charging liquor ammoniæ with sulphuretted hydrogen gas, but this is a very expensive mode, and, from the fact that most of it thus obtained is not fully charged, it would seem not to be an easy mode of making it. Having occasion some time ago to require it largely in the manufacture of sulphocyanide of ammonium, I invented for myself a mode of making it very economically, and fully charged with sulphur.

In communicating this plan to the Society I do it in the hope that it may be useful in the laboratories of those who produce some of their own reagents. The Society must not, however, give me too much credit for generosity, for had I found a market for the article making it worth my while to make it largely, I should have held it secured by patent, but as it is not, I make the gift for what it is worth. I have by this plan made the article to some extent for a London house, and have sent them some 30 to 40 carboys; but the demand was only fitful, and although they were highly satisfied with the quality and would have given me my own price, it was not worth my while to continue the process.

The mode of manufacture is merely to mix a salt of ammonia—say sulphate or chloride—with double its weight of soda waste or gas lime (either being suitable), and blowing into the mixture a jet of steam and passing the vapours through condensing apparatus; the distillate is pure sulphide of ammonium. It may be as well to mix the two bodies in a portion of water; and even in that case it is needful to be careful with the condensing pipes, as sulphide of ammonium being much more volatile than water, it comes over so strong at first as to condense in a solid form. I had nearly a serious accident with it, which I name to induce caution. I was passing the still when at work and saw something was wrong. I called my

manager, who, with the man at work, examined the pipes, and found them closed; on opening them with an iron rod there was a flow of liquor and a strong blow of gas; seeing and feeling this, I called to the man to leave it instantly, but he hesitated. My manager then seized him by the arm and pulled him away, and he instantly fell down and became rigid as a log of wood; his breast was now rubbed forcibly to bring on breathing, which had quite stopped, and a doctor who was sent for poured cold water on his head. He now went into most violent convulsions, which lasted over an hour and a half, when he got gradually round and was able to work next day. I ascribe the saving of his life to the rubbing of his breast, as complete asphyxia had taken place with the rigidity of death. Sulphuretted hydrogen is most powerful in its effects on animal life, but when combined with ammonia it seems even more active; one peculiarity of it in both forms, however, seems to be that if you escape with life it leaves no bad effects afterwards. I have myself oftener than once suffered from it, but only temporarily.

With this caution to those who attempt making sulphide of ammonium, and stating that otherwise there is no difficulty in the process, I conclude this communication.

ACADEMY OF SCIENCES.

November 26.

"*New Experimental Researches on the Silkworm Disease*," by M. J. Pasteur.

"*On Molecular Forces*," by M. Babinet.

"*Reply to M. de Parville's Remarks on the Analogy between a previously described Instrument and the Continuous Electrophorus*," by M. Bertsch.

"*On the Geographical Position of Rio de Janeiro*," by M. Liais.

"*On some Observations concerning the Porosity of Caoutchouc*," by M. le Roux.

"*Researches on Chloride of Benzyle*," by MM. C. Lauth and E. Grimaux. Chlorotoluol, C_7H_7Cl, according to M. Cannizzaro, is identical with the hydrochloric ether of benzylic alcohol or chloride of benzyle. Heated with dilute nitric acid, it becomes changed into hydride of benzoyle

$$C_7H_7Cl + 2NO_3H = H_2O + C_7H_6O + HCl + N_2O_4.$$

The change into hydride of benzoyle is more readily effected when chloride of benzyle is treated with acetate of lead These processes give very satisfactory results, and might be commercially available for the preparation of essence of bitter almonds (hydride of benzoyle) and benzoic acid. Essence of bitter almonds is also formed by acting on acetate of benzyle with nitric acid. Heated with water and freshly precipitated oxide of lead, chloride of benzyle saponifies, and produces benzylic alcohol. Thus, starting from chloride of benzyle, we obtain all the terms of the series—aldehyde, acid, alcohol, and ether. Phenate of potassium and chloride of benzyle give rise to phenate of benzyle,

$$\left.\begin{matrix} C_7H_7 \\ C_6H_5 \end{matrix}\right\} O$$

crystallising in small scales. Heated with hydrochlorate of rosaniline, or with free rosaniline and alcohol, chloride of benzyle furnishes a very beautiful and pure violet.

"*On the Action of Acid Chloro-, Bromo-, Iodo-, and Sulpho-Compounds on the Ethyl- and Methyl- Hydrocyanic Ethers*," by M. Armand Gautier.

"*On the Action of Soluble Salts of Strychnine, associated with Curara, on the Large Cetacea*," by M. L. Thiercelin. The author proposes to kill whales by poison instead of by the harpoon. He finds that it is necessary to administer a dose of 0·0005 gramme for each kilogramme of animal; therefore a whale weighing about 60,000 kilogrammes would require 30 grammes of the mixed poison. The author accordingly prepared cartridges of poison, and started on a whaling expedition. Ten whales were met with, and had the poison fired into them from a harpoon-cannon; they all died rapidly, eighteen minutes being the longest time required.

"*On a New Instrument, the Iconoscope, intended to give Relief to Plain Images examined with the Two Eyes*," by M. E. Javal. From the description we judge that this is an instrument similar to one which has long been known in England. It consists of an arrangement of prisms so placed that each eye receives an impression from the same point of view. On looking through the instrument at a picture, the eyes always preserving the same amount of convergence, and being thereby unable to judge that the objects are on a flat surface, the painting has a semblance of relief.

"*On the Vital Qualities of Beer Yeast*," by M. H. Hoffmann.

"*On a New Process for making Sulphate of Iron*," by M. Mène.

The Section of Geography and Navigation recommended that Mr. G. H. Richards, of London, should be elected correspondent, in place of Admiral Fitzroy, deceased.

NOTICES OF BOOKS.

Temperature in Acute Disease. By Thos. A. Compton, M.D. (Dub.), B.A., L.R.C.P., M.R.C.S. London: John Churchill and Sons. 1866.

In a pamphlet of about 20 pages, with diagrams, Dr. Compton gives the results of his investigations on the subject of the temperature in acute disease. The cases that have been daily investigated are 200 in number, and these temperatures have been taken at the time of day when a mean result of the temperature of the human body in health may be generally obtained, viz., at 2 p.m. Our author acknowledges with justice the value of the researches of Professor Wunderlich, Dr. Aitken, and Dr. Sydney Ringer. We think that the field is a good one, in which many a student of medicine might gain for himself laurels. Dr. Gibbon states that the normal average temperature of the axilla in a healthy adult is, in his opinion, "97° 4′—*i.e.*, one degree less than the temperature hitherto most generally received as the normal one." Surely one degree should make some difference in diagnosis, and we hope soon to record observations on temperature, which may settle the question. The only way to obtain this is for the varying conditions, ages, temperaments, &c., of healthy people, to be taken into consideration over an extended area, and tables for accurate use to be drawn up, so that we shall not state that x is the abnormal temperature of a patient old or young, but that x is by so much greater or less than the normal y for that age, condition, sex, &c. We believe that the subject is sufficiently fresh for such accuracy to be attained as may be consistent with the demands of ordinary clinical practice. The question is certainly of sufficient interest to repay any amount of labour, careful and accurate, that may be expended upon it, and all who have the power should add their mite. We make these remarks now, because Dr. Compton's book shows how these researches may be carried out, and we may safely recommend it for the purpose. At present we want accurate results without theories. We can endorse the concluding note of the pamphlet:—"The instruments used in these observations were manufactured by Messrs. Casella (of Hatton Garden, London), whose clinical thermometers can always be depended upon. No reliance can be placed on registration taken with the ordinary German thermometers as generally imported into this country, as I have found the error in some of them to be as much as 2° Fahr. when compared with a standard instrument. *English thermometers are, consequently, strongly recommended.*" We may

add that good English instruments may also be obtained from Messrs. Cetti and from Messrs. Negretti and Zambra. The methods and instruments for research are within the reach of pathologists; workmen only are now wanted. We must protest, however, against the notion that a mass of reports is needed. A few reliable results will be invaluable; a number of inaccurate statements without regard to sources of fallacy cannot fail to retard the success of ultimate results.

NOTICES OF PATENTS.

Dyeing, &c. William Dancer, Cornbrook, Hulme. (Provisional protection only.) Dated March 17.

This invention consists in the production of new purple and blue colours upon textile fabrics or yarns, for which purpose the patentee employs the well-known aniline dye "magenta," and other similar colours. These colours, or salts of these colours, he reduces and obtains leucaniline and similar bodies; having obtained such bodies, he next acts upon them or their salts by means of acetic, aldehyde, acrolein, or other aldehydes, or mixtures of the same. In this manner new compounds are produced, which may be printed or put upon the textile fabrics or yarns, and afterwards submitted to the action of bichromate of potassium or other oxidising agents of a similar kind, when the new colour will be produced and at the same time fixed upon the material employed, the shade of colour produced depending upon the respective quantities of aldehyde and leucaniline. Violets and blues may also be produced by the oxidation of the compounds obtained by acting upon leucaniline by means of iodide of ethyl, iodide of isopropyl, aniline, and benzoic, and similar acids in a similar manner to that employed for their production from rosaniline or its salts. The proportions used are about as follows:—For one gallon of colour take the amount of leucaniline, obtained by reducing four ounces of rosaniline or magenta, boil this for about five minutes with three ounces of aldehyde, precipitate with caustic soda or lime, and dissolve the precipitate in one gallon of dilute acetic acid.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

Communicated by Mr. Vaughan, F.C.S., Patent Agent, 54, Chancery Lane, W. C.

2168. W. Welch, King Street, Southsea, Hants, "Improvements in the manufacture of cement compositions, and in the method of applying and securing plastic cements to iron and other surfaces."—Petition recorded August 23, 1866.

2779. J. Sharp and R. Smith, Blackford, Perth, N. B., "An improved explosive compound or powder."—October 27, 1866.

2873. N. F. Taylor, Manby Street, Stratford, Essex, "Improvements in means for operating on air or aëriform fluids by hydrocarbons for purposes of illumination."—November 6, 1866.

3002. W. Grüne, Berlin, Prussia, "A chemical decoration on gold, silver, and other similar metals, and colours on porcelain, glass-wares, crystal-wares, delft-wares, potters'-wares, and similar matters, called 'Grüne's proceeding.'"—November 15, 1866.

3014. A. E. Blavier, Angers, France, "A proceeding of conservation of cereals and substances, alimentary, vegetable, and animal."—November 17, 1866.

3030. A. P. Price, Lincoln's Inn Fields, "Improvements in the manufacture of carbonate of soda." A communication from Dr. A. Blügel, Utrecht, Holland.—November 19, 1866.

Notices to Proceed.

1846. A. Prince, Charing Cross, Middlesex, "Improvements in the means of preserving timber from decay." A communication from G. P. Ball, New York, U.S.A.—Petition recorded July 13, 1866.

1885. R. Irvine, Magdalen Bridge, Mid Lothian, N.B., and P. Brash, Leith, Mid Lothian, N.B., "Improvements in the treatment of certain residues in order to obtain fatty acids therefrom."—July 19, 1866.

1915. G. Mountford, Grasscroft, near Greenfield, Yorkshire, and G. L. Loveridge, Hayes Street, Manchester, "Improvements in the tanning of hides and skins."—July 23, 1866.

2204. H. A. Dufrené, Rue de la Fidélité, Paris, "Improvements in the manufacture of beer and other alcoholic liquids, and in the apparatus employed therefor." A communication from C. Tellier, Rue Boulainvilliers, Passy, Paris, August 27, 1866.

2778. E. Howard, Redhill, Surrey, "Securing perfect immunity from danger in the use of paraffin, camphine, and other lamps, liable hitherto to explode, whether fed by rock oil, crystal oil, paraffin, camphine, belmontine, or other combustible carbonaceous oils."—Oct. 27, 1866.

2924. W. E. Newton, Chancery Lane, "Improvements in treating vegetable substances chiefly applicable to the manufacture of paper pulp and fibres." A communication from B. C. Tilghman, Philadelphia, Penn., U.S.A.—November 9, 1866.

CORRESPONDENCE.

Decomposing Water with the Induction Coil.

To the Editor of the Chemical News.

Sir,—Can any one inform me if, by any arrangement, it is possible to decompose water by the induction coil? I have tried the experiment, but failed—the current passing through the acidulated water without producing any perceptible effect. Is not the current of the coil alternately positive and negative, thus neutralising itself?

I am, &c. E. W.

Manufacture of Iodine.

To the Editor of the Chemical News.

Sir,—Like your correspondent, Mr. Paterson, I have been a subscriber to the Chemical News since the commencement of its publication. I have also observed the inquiry in reference to iodine in No. 364, and Mr. Paterson's reply in No. 365; but as he has omitted to give the names of any manufacturers except himself, I beg to subjoin the following, which, I believe, includes the names of all the iodine manufacturers in Great Britain:—William Paterson, Glasgow; John Ward and Co., Glasgow; The British Seaweed Company (Limited), Dalmuir, near Glasgow; John Carrol, Mile-end, Glasgow; F. R. Hughes and Co., Borrowatouness; John Loughran, Ramelton, Ireland; The Irish Marine Salt Company (Limited), Galway.

I am, &c. Kelp.

Glasgow, December 3.

Durability of the Atlantic Cables.

To the Editor of the Chemical News.

Sir,—It seems to me that Mr. Spiller's communication respecting the duration of the Atlantic cables is calculated to inspire unnecessary alarm. He seems entirely to have overlooked the fact that the iron sheathing of the cables was merely provided to give sufficient weight to sink them, and also tensile strength sufficient to overcome the immense strain exerted on them while suspended in the ocean. No strain exists upon them now, lying as they do half sunk in silt in the bed of the Atlantic. The only parts about which anxiety may be felt are the shore ends and those portions passing over the Irish bank. But the former may be renewed at any time without affecting the main cables, and the latter we must suppose to lie upon the declivity in such a manner, owing to the large amount of slack there

paid out, that no strain is felt upon them any more than in other parts of the cables.

The iron sheathing being eaten away does not destroy the cables, as the double insulating case is quite unacted on by the salt water. But there is no reason to suppose that the iron sheathing will be so rapidly eaten away. For three reasons I argue that it will last a great length of time. Firstly, owing to the protection afforded by the hemp (which might, however, have been tarred); secondly, that owing to the stillness of the water at such depths the stratum of ferric chloride formed will prevent, by its slow diffusiveness, fresh sea water from acting on the iron; and thirdly, the silt will be slowly and continuously deposited on the cables, forming an impervious siliceous or calcareous sheath. There is, I think, therefore no reason to fear the loss of the cables for many years to come. I am, &c. T. B.

MISCELLANEOUS.

Disinfectants and Deodorisers.—The Lords of the Admiralty have ordered that the use of Burnett's disinfecting fluid shall be discontinued in the Royal Navy, in consequence of several fatal cases of poisoning having occurred, from its having been accidentally swallowed by seamen. Moreover, it has been discovered that the Burnett's fluid is not a disinfectant, but only a deodoriser. Carbolic acid is now to be used throughout the fleet.

The Royal Society.—At the general meeting of this Society on November 30, the following elections took place:—*President*—Lieut.-General Edward Sabine, R.A., D.C.L., LL.D. *Treasurer*—William Allen Miller, M.D., LL.D. *Secretaries*—William Sharpey, M.D., LL.D., and George Gabriel Stokes, Esq., M.A., D.C.L., LL.D. *Foreign Secretary*—Prof. William Hallows Miller, M.A., LL.D. *Other Members of the Council*—Lionel Smith Beale, Esq., M.B.; William Bowman, Esq.; Commander F. J. Owen Evans, R.N.; Edward Frankland, Esq., Ph.D.; John Hall Gladstone, Esq., Ph.D.; William Robert Grove, Esq., M.A., Q.C.; William Huggins, Esq.; Thomas Henry Huxley, Esq., Ph.D.; William Lassell, Esq.; Prof. Andrew Crombie Ramsay, LL.D.; Colonel William James Smythe, R.A.; William Spottiswoode, Esq., M.A.; Thomas Thomson, M.D.; William Tite, Esq.; Vice-Chancellor Sir W. P. Wood, D.C.L.; and the Lord Wrottesley.

Royal Polytechnic Institution.—On Monday evening, at the invitation of Mr. Pepper, we witnessed a new optical illusion at the Polytechnic—the Decapitated Head. Many of our readers are well acquainted with the optical principles on which these illusions depend, but it is well worth a visit to see the detail carried out in the way that it is at this Institution. The Cherubs still float in the air, so that there are now two of these very clever illusions exhibited here. Some of Dr. Tyndall's experiments have also been brought recently before the public in the lecture on Combustion by Invisible Rays. Experiments showing the propagation of waves were shown, also the effect upon sulphate of quinine paper of the ultra-violet rays of the spectrum. The absorbent power of a solution of iodine in bisulphide of carbon over luminous rays, and its transparency to heat rays, was rendered strikingly evident by igniting paper, a cigar, etc., when such bodies were held in the focus of the rays issuing from the electric lamp after passing through the solution. At the conclusion of the lecture, the attention of the audience was drawn to the improved ventilation of the theatre; there is now no fault to be found in this respect, although previously it was very imperfect. In this brief notice we have confined ourselves to the more scientific part of the entertainment, but visitors who prefer lighter amusement are also provided for. We understand many novelties are in preparation for Christmas, and those who have watched the success which the energetic director has met with each year, both in the scientific novelties and popular entertainments provided for his holiday audience, will have no reason to fear that such judiciously administered doses of science will ever be unpopular with the rising generation.

On the Effect of Temperature on Organic Matter in Water.—Dr. Frankland writes: "With regard to the temperature at which the putrefaction and decay of organic matter in water take place, I find that the following is all that appears in the printed report of my evidence on the subject in the case 'Duke of Buccleuch and others *v.* Alexander Cowan and others,' recently tried at Edinburgh. 'Where a river becomes sluggish—as where it is pent up by a weir—the quantity of organic matter, and also of mineral matter, increases in some cases very considerably; but that is only the case in warm weather, and the temperature of the water must be 55° Fahrenheit and upwards, for this effect to be produced. The putrefaction of the mud in the bed of the river ensues, and the previously insoluble matter becomes soluble matter.' The safest and most sensitive test of putrefaction in water is the relative proportion of oxygen to nitrogen in the dissolved gases. The river North Esk as it flowed through the Duke of Buccleuch's grounds at Dalkeith Palace, in March and in June last, afforded striking evidence of this kind as to the effect of temperature upon the absorption of oxygen by the organic matter of water (it is only when the whole of the oxygen dissolved in the water is consumed, that the latter assumes a true and offensive putrefactive condition). On the 3rd of March the temperature of the water in the North Esk was 38° Fahrenheit, and the proportion of oxygen to nitrogen in the dissolved gases was $O:N = 1:2{\cdot}02$. This is the normal proportion in water free from organic matter. On the 21st of June the river emitted a putrid odour, the temperature of the water was 60° Fahrenheit, and the proportion of oxygen to nitrogen was $O:N = 1:25$; thus the amount of dissolved oxygen was reduced to a mere trace, and the organic matter was in a putrescent condition."

Storm Warnings and Weather Reports.—The Board of Trade has issued the following circular, dated November 29:—"The Board of Trade have had under consideration the report of a committee appointed by the Royal Society, the Admiralty, and the Board of Trade, to inquire into the constitution and functions of the Meteorological Department, which recommended, as the most important step to be taken, the transfer of the management of the business of the department to a scientific body. The Board of Trade have also consulted the Royal Society on the subject of this report, and the President and Council of the Royal Society concur generally in the measures recommended by the committee, and are prepared to undertake the duty proposed to them. With regard to the issue of storm-warnings, the President and Council of the Royal Society are of opinion that 'at present these warnings are founded on rules mainly empirical,' and, therefore, should not be issued under the superintendence of the scientific body to whom the discussion of meteorological observations will be committed. The President and Council think, however, that 'in a few years they may probably be much improved by deductions from the observations in land meteorology, which will by that time have been collected and studied; and that the empirical character may thus be expected to give way to one more strictly scientific, in which case the management of storm-warnings might be fitly undertaken by a strictly scientific body.' Under these circumstances the Board of Trade are compelled to suspend, from December 7 next, 'Cautionary Storm Warnings,' which have from time to time been issued by the Meteorological Department of the Board of Trade.

It is hoped that the warnings may be resumed by the new Meteorological Department at no distant time upon an improved basis. In the meantime the daily 'Weather Reports' will be received and published as heretofore. If at any port or place there is a desire to have these reports, or any part of them, communicated by telegraph on the morning on which they are received, they shall be so communicated on a request to that effect being sent to the Board of Trade, accompanied by an undertaking to pay the expense of the telegram from London to the port or place.—T. H. Farrer."

Crystal Cod-liver Oleine.—Some weeks ago we noticed an essay by Bedford Brothers on cod-liver oleine. We have seen the oleine, and can say that it is, as described, of a pale amber colour, almost destitute of odour, and so tasteless as to be unobjectionable. The oil bears subjection to an extreme degree of cold without signs of deposit of solid fatty matter, and is virtually a pure oleine, the quantity of stearine or margarine present being so small as to exclude the idea of any medicinal action being derived from them. We are not called upon to offer any opinion as to the medicinal advantages of oleine over margarine, but medical practitioners of eminence have found that the oleine of cod-liver oil is the best constituent. It is unnecessary for us to enter into detail, but we may state that it would be difficult for a cod-liver oil to be offered of a more palatable character than the crystal oleine in question.

New Process for extinguishing Fires.—Our attention has been drawn to a new process for extinguishing fires in mills, steamships, and other buildings, by means of carbonic acid and nitrogen gases, which has recently been patented by Messrs. Dawson and Co., of Milnsbridge, Huddersfield. The process can be carried out with a facility which could have been hardly expected. By forcing the enormous volume of gases, which arise from the combustion of ordinary fuel in furnaces of ordinary steam boilers, &c., first through a cooling chamber, and thence into a room, it is easy to maintain outward currents of those gases for any length of time, through any reasonable amount of openings, such as broken windows, crevices, &c., which are likely to exist; and thus in effect to completely seal the room from the external atmosphere, and also to keep the temperature so low as not to injure the most delicate materials or machinery. On July 25 last about 1000 persons assembled in the vicinity of the chemical works of Messrs. Dawson and Co., to witness an experiment made by the patentees. It was determined by the firm to set on fire an upper room of one of their numerous buildings, in which should be placed a large pile of wood and shavings, sprinkled with spirits of wine and other inflammable liquids, so as to prove, to a demonstration, the power of the patent. The room, about 100 feet by 20 in size, was lighted in several places simultaneously, and very quickly the flames, burning bright and clear, were seen by the whole of the persons present. No doubt whatever was entertained but that the fire had got a firm hold, and if the patent was not genuine, the mill would shortly be burned to the ground. One of the firm then went round to where the appliance was situate, and set the apparatus to work. In less than one minute, the fire, which had been gaining in intensity every moment, owing of course to the ignitable nature of the material in the room, was put out, and not a vestige of its presence remained, except in the blackened roof and sides of the building, and the charred wood and shavings in the room. The gases were conducted into the room where the fire existed by means of flues; and as soon as a certain proportion of these gases to the atmospheric air in the room was arrived at, combustion was at once arrested. The necessary gases can be obtained in great abundance, and for any length of time, at a very short notice and at a small cost—three or four tuns not costing more than a few shillings. Numerous experiments made upon the gases taken from chimneys, under varying circumstances, have proved that they can easily be obtained of the proper quality for the purpose. It has been found that, by ordinary good firing with covered grates, the oxygen of the atmosphere is thoroughly consumed by the fuel, and even that the gases are efficient with one-third of their volume of atmospheric air in admixture.

Agates.—The Reese River (California) *Reveille* says, that about three miles north of Ione there is an isolated mountain, some five hundred feet high, which is called Agate mountain. Its entire surface upon all sides from summit to base, is covered with agates and concretions, and on digging into the soil they are found like potatoes in a hill. The agates are usually oval and sometimes globular in form, and varying from one to four inches in diameter, and are beautifully banded and striped. In the hands of a skilful lapidary they could be fashioned into pleasing ornaments. The various concretions are found in great abundance, and many of them are particularly beautiful. In their sphericity they are sometimes found as perfect as a ball, though generally the spherical shape is quite distorted. They are hollow, and usually filled with cryatals. On breaking them open their interior is often found to be irregularly hollow and lined around with a layer of quartz crystals, forming what is termed a geode—a "little crystal grotto." Some of these hollow concretions contain a smaller concretion inside, which rattles when shaken in the hand.—*Drug. Circ.*

Meetings for the Week.

Monday, December 10.

Medical Society, 8 p.m.

Tuesday, December 11.

Royal Medical and Chirurgical Society, 8½ p.m.

Photographic Society, 8 p.m.

Wednesday, December 12.

Society of Arts, 8 p.m.

Thursday, December 13.

Royal Society, 8½ p.m.

Friday, December 14.

Astronomical Society, 8 p.m.

ANSWERS TO CORRESPONDENTS.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

Vol. XIII. of the Chemical News, containing a copious Index, is now ready, price 11s. 6d., by post, 12s. 6d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I., II., and VII. are out of print. All the others are kept in stock. Vol. XIV. commenced on July 6, and will be complete in 26 numbers.

Chemi.—Small specimens of indium are to be obtained at some operative chemists' in London; but the price is by no means low.

H. S. P.—We do not know that any special account has been given of the method employed in blasting underground with gun cotton. Can any of our readers favour us with the required information?

Phototype wishes to be informed where he can meet with an account of the experiment in which a ray of light falling on a silver plate has deflected a galvanometer.

W. Skey.—We have to thank our correspondent for two additional papers—No. 8, "*On the Effect of Ammoniated Copper upon Vegetable Fibre*," and No. 9. "*On the Nature of the Gas which is given off from Fresh Charcoal when immersed in Water.*" Their publication shall follow that of the papers already in hand.

An Exhibitor.—You had better apply at the office at South Kensington. If your allotment is not taken possession of by February 15, they will be treated as resigned, and appropriated to the purposes of the exhibition. We believe March 10 will be the last day on which chemicals can be deposited in the building.

Received, with thanks.—Dr. Letheby; J. Cliff.

Books Received.—"Inorganic Chemistry," by Geo. Wilson, M.D.; revised and enlarged by S. MacAdam, Ph.D., &c.—"Elements of Chemistry:" Part III., Organic Chemistry, by W. Allen Miller, M.D., &c.

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THE

CHEMICAL NEWS

AND

Journal of Physical Science.

Edited by] [*Wm. Crookes, F.R.S.*

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INDIAN MEDICAL SERVICE.

India Office, S.W.,
10th December, 1866.

NOTICE is hereby given, that an EXAMINATION of Candidates for 25 Appointments as Assistant-Surgeons in her Majesty's Indian Medical Service will be held at CHELSEA HOSPITAL, on the 11th FEBRUARY, 1867, at 10 a.m.

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The FRIDAY EVENING MEETINGS will commence on January 18th. The Discourses before Easter will probably be delivered by Profs. Tyndall, Max Müller, and Odling, the Rev. W. Farrar, Mr. M. D. Conway, Capt. V. D. Majendie, Rev. W. Greenwell, Mr. E. B. Tylor, Dr. James Bell Pettigrew, Mr. Balfour Stewart, and Prof. Frankland.

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THE DISCOVERY OF THE SODIUM AMALGAMATION PROCESS.

Of all controversies, those relating to priority of discovery are the most uninteresting both to the claimants and to the public, the most difficult to settle, and the most unsatisfactory when settled. It has been my misfortune already to pass through one such controversy, in which the points at issue turned upon the question whether April, 1861, or May, 1862, happened first in chronological order, and whether May 1 occurred before or after May 16; and I have been resigned, after a wearying and harassing argument, extending over many months, to abandon the contest for Continental recognition as hopeless; for, in spite of all my efforts, it appears to have been decided, by the weight of academic and personal influence, that in French scientific works thirteen months are to be blotted out of the chronology of discovery.

It seems as if a similar controversy were imminent with respect to sodium amalgamation. Some courteous, straightforward, and most flattering remarks* of Professor Henry Wurtz, of New York, have been seized upon by certain writers in English newspapers, and by them either garbled and twisted into an insinuation of unjustifiable misappropriation,† or assumed to be sufficient reason for the entire suppression of my name.‡

It is very probable that anything I may adduce in answer to these newspapers will fail to neutralise the effect of their remarks. An error, once circulated by the press, retains the vitality of its injurious influence to all time, for an accusation of this sort has a piquancy which its refutation seldom possesses. And were it not that my silence, actuated really by utter weariness and detestation of barren and fruitless controversy, has already been misconstrued into concession, and that, persisted in longer, it might seem to justify that interpretation, I should assuredly have allowed such trifles to pass unnoticed.

In reply, then, to Professor Wurtz's remark about concession, may I be allowed to state that in questions of priority of discovery it is quite out of the power of either claimant to make concessions to the other? The settlement of the question must rest upon certain dates and facts; and all we can do is, to state these data clearly and temperately, and to receive with equanimity whatever decision may logically be deduced from them; therefore, the "concession" of a date or fact means the suppression of a truth.

It is a very common error in scientific ethics that "priority of publication constitutes priority of discovery." I venture to say that this rule has no existence, and, from the nature of the case, it can and ought to have none. Professor Asa Gray, one of the leading scientific men in the United States, has commented very clearly on this point, and his decision is now universally accepted. He says§:—"The fact of a *discovery* is to be established by evidence, and no sort of evidence by which it may be established can be excluded. Abundant illustrations of this may be adduced from the history of almost every science. The rule which has here been misapprehended is one which fixes *nomenclature*. Naturalists have established, and physicists adopted, the very necessary rule that the publication is essential to give reality to a *name*, that the name first published takes precedence. The discovery of a fact or a thing, and the imposition of a name, are two different matters, and not rarely dissociated. The first is to be established by any good evidence; the second is governed by an arbitrary but most just rule."

The date of a discovery is a question of *fact*, and not a question of nomenclature, and may be authenticated by whatever testimony can be adduced.

Now, supposing that this question of priority involved any scientific honour, any pecuniary advantage, or were even likely to interest any one in the remotest degree, I could prove that, as long ago as 1861, the sodium amalgamation process was not only matured in my mind, but fully described on paper and handed by me to a well-known New York firm for publicatio n. I could show that it has been a common topic of discussion with my scientific friends any time within the last seven years;—that in 1864 the process was so much a matter of conversation, that I was urged to lose no time in securing my rights by a patent;—that about the same time successful experiments on a somewhat large scale were conducted at Manchester on rich Californian quartz;—that early in 1865 equally conclusive experiments were tried in conjunction with Mr. Readwin, both at Manchester and in North Wales;—that the first publication of the process in this or any other country (even antedating that of both our patents) was communicated personally by myself to the editor of the *Mining Journal*, and by him published in June, 1865. All this would not be difficult to prove.

No doubt Professor Wurtz, did he care about it, could adduce similar evidence, which would prove beyond a doubt that he also had an acquaintance with the process before he patented it: but *cui bono?* There being neither honour nor profit, but only worry and loss of time, to be derived from this unsatisfactory exhumation of evidence, why will contemporary writers not allow Professor Wurtz and myself the credit of *each* having made an independent discovery? The history of invention abounds

* "I shall but refer briefly to the conflicting claim to priority of discovery which was entered by Mr. Wm. Crookes, one of the most learned, industrious, and successful of the English scientists. The graceful concession of this point which Mr. Crookes is considered of late, both by scientists and jurists, to have made, by his own silence, and by publications in the journals ostensibly authorised by him, it is thought will not prove any appreciable detraction from the laurels so well and worthily won by him in the field of chemical discovery." From a paper on "The Utilisation of Sodium in Gold and Silver Amalgamation," read before the American Association for the Advancement of Science, by Prof. Henry Wurtz, of New York City. See also *Silliman's Journal*, vol. xli., p. 216.

† ". . . More especially as in England we are accustomed to attribute its origin to one who has already had the annoyance of having his right to another chemical discovery seriously disputed . . . Dr. Wurtz has fair grounds for demanding at least some explanation from Mr. Crookes to account for the apparent plagiarism."—*Mining Journal*, April 13, 1866.

‡ ". . . Professor Henry Wurtz, of New York, the gentleman to whom the honour of having discovered the sodium process is now generally conceded."—*Mining Journal*, November 24, 1866.

"The honour of having discovered the sodium process is generally conceded to Professor Henry Wurtz, of New York."—*Mechanics' Magazine*, November 30, 1866.

§ *Silliman's Journal*, September, 1863.

with analogous cases, and I am willing to believe that the discovery of the practical value of sodium in gold and silver amalgamation was a *bonâ fide* discovery on the Professor's part, as I hope he believes it to have been on mine. But for me to concede the discovery—that is, to admit that I have no claim to the credit of *originality*—is as much out of my power as it is far from my intention, involving as it does both the suppression of facts and the possession of an unreasonable amount of self-abnegation.

William Crookes.

SCIENTIFIC AND ANALYTICAL CHEMISTRY.

The Polymeres of Acetylene: Second Part, Benzol, by M.* Berthelot.

Benzol is the principal, but not the only, product of the condensation of acetylene. The following are my observations on the subject:—

I. 1. The liquid obtained by this condensation begins to boil at about 50°, and furnishes, first a mobile and very volatile carbide, with a penetrating and alliaceous odour; concentrated sulphuric acid absorbs and destroys it immediately, taking a red colour. It is probably diacetylene—

$$C_8H_4 = 2C_4H_2.$$

But I have not been able to obtain it in sufficient quantities for examination.

2. Then comes benzol, or triacetylene—

$$C_{12}H_6 = 3C_4H_2.$$

The boiling point rises rapidly from 90° to 135°. Between 135° and 160° I collected styrol or tetracetylene—

$$C_{16}H_8 = 4C_4H_2.$$

The proportion rises to about a fifth of the total product. This carbide appears to me perfectly identical with the styrol furnished by the decomposition of cinnamate of potash, according to the following characteristics:—1. Boiling point; 2. Odour; 3. Action of sulphuric acid (transformation of the carbide into polymeres; 4. Action of fuming nitric acid; Action of bromine (production of characteristic crystallised bromide); 6. Action of free iodine (immediate transformation of the carbide into polymeres); 7. Action of iodureted iodide of potassium (immediate formation, without the aid of heat, of iodide of styrolene in beautiful crystals, spontaneously destroyed in less than an hour, with regeneration of the iodine and formation of a polymere). No other carbide among those I have tested has produced an analogous crystallised iodide, under the influence of the same reagent.†

I have ascertained that tetracetylene possesses all these peculiarities, and notably the specific formation of crystallised bromide and iodide.

4. After styrol, the boiling point rises rapidly to about 210°. I collected separately what passed between 210° and 250°. This product remaining liquid, I placed it in a refrigerating mixture, which determined the separation of a crystallised body; I expressed it from the mixture, and then recrystallised it. It proved to be naphthaline, $C_{20}H_8$, which I verified by its properties in the free state, by the formation of nitronaphthaline, finally by examining the combination formed by this carbide with picric acid dissolved in alcohol. This characteristic combination was discovered by M. Fritzsche.

Naphthaline is here derived from 5 molecules of acetylene, with separation of hydrogen—

$$C_{20}H_8 = 5C_4H_2 - H_2.$$

It seems to me probable that the liquid in which it was dissolved may be pentacetylene—

$$C_{20}H_{10} = 5C_4H_2,$$

formed directly by acetylene, but soon partially decomposed, with loss of hydrogen, and thus producing naphthaline—

$$C_{20}H_{10} = C_{20}H_8 + H_2.$$

Naphthaline is also formed, but in much smaller quantities, by passing pure acetylene through a tube, heated to bright redness, when it is resolved almost entirely into carbon and hydrogen.

5. Between 250° and 340° there passed various liquids, possessing in a high degree the fluorescence characterising pyrogenous resin-oils and others analogous to them. These liquids cooled quickly, furnished no crystals. I have not otherwise studied them, for want of means of comparison; but it seems to me likely that they contain polymeres six, seven, and eight times condensed.

6. Towards the boiling point of mercury a considerable quantity of a crystallised carbide was distilled, in the form of brilliant plates, impregnated with liquid. After being purified, this carbide had the properties of retene, and, with picric acid, furnished the compound discovered by M. Fritzsche.‡

I will here mention that retene has been obtained by M. Knauss by distilling a tar from resinous wood, and examined by M. M. Fehling. This carbide is very important, on account of its diffusion; not only is it found in pyrogenous products, but it has also been observed in various turfs and fossil resins; the bodies called fichtelite, scheererite, and phylloretine, are identical with retene.

After its generation by means of acetylene, retene must be regarded as enneacetylene—

$$C_{36}H_{18} = 9C_4H_2.$$

7. This was not the end of the condensation. After it had passed, tarry products remained in the retort. Part of it was still capable of being distilled, while the rest was destroyed, with formation of carbon. I have not fully studied these substances.

II. Great light is thrown upon the formation of pyrogenous carbides by the preceding facts, and by those I have already published on the direct combination of acetylene with other carbides. The process by which is effected the progressive accumulation of organic molecules, to form complex derivatives, is here clearly shown, and it furnishes a demonstration of the theory by which I interpreted the simultaneous formation of the carbides $C_{2n}H_{2n}$, in the distillation of formiates and acetates. But while the condensations take place only on the nascent carbides C_2H_2, in the latter case, on the contrary, acetylene gives an example of a carbide quite as simple, and capable of similar condensations, directly and in the free state.

I will here observe that the explanation of the theory of homologues may be found in synthetical phenomena. Nevertheless, it must not be regarded as a particular consequence of the polymeric condensation and the

* *Comptes Rendus*, lxiii., 515.

† It only succeeds with pure, or nearly pure styrol, iodide of styrolene being very soluble in liquid carbides, and not being capable of reproduction by the evaporation of its solutions.

‡ I have compared this carbide with a specimen of retene kindly supplied by M. Fritzsche.

ulterior combination of polymeric carbides with other bodies, simple or compound. Thus is explained, to confine ourselves to an example from the homologous bodies, the parallelism of the benzoic series, derivatives of triacetylene, with the styrol series, derivatives of tetracetylene.

$C_{12}H_6 = (C_4H_2)_3$, benzol.
$C_{14}H_6\ O_1 = (C_{12}H_6)C_2O_4$, benzoic acid.
$C_{14}H_8\ O_2 = (C_{12}H_8)C_2O_2$, benzylic aldehyde.
$C_{14}H_8\ O_2 = C_{12}H_4(C_2H_4O_2)$, benzylic alcohol.
$C_{36}H_{30}O_2 = C_{12}H_4(C_{11}H_{23}O_2)$, sycocerylic alcohol.
$C_{16}H_8 = (C_4H_2)_4$, styrol.
$C_{18}H_8\ O_4 = (C_{16}H_8)C_2O_4$, cinnamic acid.
$C_{18}H_8\ O_2 = (C_{16}H_8)C_2O_2$, cinnamic aldehyde.
$C_{18}H_{10}O_2 = C_{16}H_6(C_2H_4O_2)$, cinnamic alcohol.
$C_{52}H_{44}O_2 = C_{16}H_8(C_{36}H_{38}O_2)$, cholesterine.

This parallelism shows the possibility of the existence of a multitude of as yet unknown styrol derivatives, and more generally that of the regular derivatives of various polyacetylic series.

Remarks on M. Stas's Memoir on Atomic Weights, by M. Marignac.

Five years ago* I gave an account of a memoir by M. Stas on atomic weights. After having bestowed on this remarkable work the praise it justly deserved, and having also declared that the author appeared to me to have attained the utmost limit of accuracy possible in researches of this nature, I took the liberty of expressing some doubts, not on the exactitude of his determinations, but on the certainty of the conclusion he drew from them—*i.e.*, that no simple relation exists between the atomic weights of bodies. I expressed a wish to see these determinations repeated by more varied methods, in order that it might be proved that the variations which would result from them in atomic weights, were far from reaching the differences which manifest themselves between the numbers thus attained and those which must be admitted if simple relations between the atomic weights of different bodies are supposed; and that these differences cannot be attributed to anomalies in the composition of the combinations used in analysis in the determination of atomic weights.

In the preface of his new memoir† M. Stas combats this objection, exaggerating its signification. He considers it as the negation of the principle of definite proportions and the invariability of atomic weights. I never gave it such a signification, nor had I any idea of casting a doubt on this fundamental principle of chemistry.

But I ask if it may not happen that certain compounds (though they appear to us to offer very definite characters and a constant composition) may contain a little excess of one or other of their elements, in consequence of the particular conditions which must have been fulfilled for their preparation and purification. As an example I quote monohydrated sulphuric acid, which it was for a long time believed must have a perfectly definite composition, when in such a state as to experience no further change by ebullition; whilst it is now certain that it then contains a minute excess of water. This is no reason why there should not be a monohydrate of perfectly normal composition, such as is obtained by crystallisation. I confess that I shall maintain the doubt which I then expressed for each compound, till it shall have been proved by rigorous comparative experiments, that the methods employed for its preparation really produce it in a state of absolute purity. I hasten to say that M. Stas's new experiments prove to me most satisfactorily that the objection I had raised has no foundation for any of the bodies on which this *savant* had grounded his determinations. But his works themselves show us what caution must be observed before certifying that a body has been obtained in a state of purity. Has he not, indeed, proved that iodide of silver prepared by means of the nitrate of this metal cannot in any way be divested of an excess of this salt, and that hitherto it has been absolutely impossible for him to obtain a chloride of potassium which does not contain a trace of silicic acid?

If certain bodies cannot be completely purified from mixture with a foreign substance, may it not also happen that, in a similar state of mixture, they possibly contain an excess of one of their elements? Be this as it may, I do not at all regret having raised these objections, if they have in any way contributed to the production of the new series of researches which M. Stas has just published. It is a magnificent work, which will remain a model of patience and perseverance in surmounting difficulties, and of ingenious methods for carrying analytical and synthetical experiments to the highest degree of precision.

But it would be impossible to give an idea of it by an extract. It is a book to be consulted by all chemists who wish to devote themselves to researches requiring rigorous exactitude. I must confine myself to remarking some of the most important results obtained by the author.

The first memoir is devoted to proving the constancy of chemical proportions. To this end M. Stas first determines the relation between chlorides of ammonium and silver, by varying the conditions of preparation of the first salt, and by ascertaining its reaction on the solution of silver, whether cold or at 100°. The constancy of the results obtained in these different circumstances proves that chloride of ammonium and chloride of silver present no perceptible variation in their composition.

Another proof of the invariability of chemical proportions is given by a series of experiments relative to the transformation of chlorate, bromate, and iodate of silver into chloride, bromide, and iodide, under the deoxidising influence of sulphuric acid. M. Stas shows, by taking the minutest precautions and by working on very considerable weights of materials, that these transformations take place with the most perfect exactness, without any trace of silver or of chlorine, bromine, or iodine being found in excess. In the following memoirs M. Stas (whether by the same or by new methods) repeats the determination of the atomic weights which he had established a few years ago, and thus responding to the wish I had expressed, he shows that various methods, resting on the synthesis or analysis of entirely different compounds, lead to almost identical results. This gives a fresh confirmation to the law of chemical proportions. As examples, I quote the results obtained for silver and nitrogen.

The mean atomic weight of silver is:—

1st. By synthesis of the sulphide and analysis of the sulphate	107·920
2nd. By synthesis of the iodide and analysis of the iodate	107·928
3rd. By synthesis of the bromide and analysis of the bromate	107·921
4th. By synthesis of the chloride and analysis of the chlorate	107·937

* *Bibliothèque Universelle de Genève*, December, 1865, t. xxiv., p. 271, and Chem. News, vol. v., p. 57.

† *Archives des Sciences Physiques et Naturelles* (Nouvelle Période), t. ix., année 1860, p. 97, and Chem. News, vol. xiv., pp. 75, 87, 205, 218, 229, 241.

The atomic weight of nitrogen is :—

From the relation of chloride of potassium to the nitrate	14·043
From the relation of chloride of sodium to the nitrate	14·048
From the relation of chloride of lithium to the nitrate	14·046
From the relation of chloride of silver to the nitrate	14·044
According to the synthesis of nitrate of silver	14·042

It may be judged by the comparison of these numbers to what a degree of precision the author has attained in such difficult researches, and how impossible it is to attribute to errors of experiment the differences which appear between these numbers and those required by Prout's law—*i.e.*, 108 for silver and 14 for nitrogen.

In conclusion, as a summary of this immense work, these are the atomic weights which result, for some simple bodies, from M. Stas's experiments. I have compared his recent determinations with those he had obtained in his first work, to show how little modification the latter have required, notwithstanding the unheard-of precautions to which he has subjected himself in his new experiments. These numbers are related to the atomic weight 16, adopted by hypothesis for oxygen. In this table I have entered the atomic weight of hydrogen, which is admitted by the author to be most probable, according to the *ensemble* of the researches relative to this body :—

	1865.	1860.
Oxygen	16	16
Hydrogen	1·025	—
Silver	107·930	107·943
Nitrogen	14·044	14·04
Bromine	79·952	—
Chlorine	35·457	35·46
Iodine	126·850	—
Lithium	7·022	—
Potassium	39·137	39·13
Sodium	23·043	23·05
Sulphur	—	32·074
Lead	—	206·91

According to M. Stas, the examination of these numbers entirely justifies the conclusion which he had announced in the sequel of his first work—*i.e.*, that Prout's law is a pure illusion, and that no simple relation exists between the atomic weights of bodies.

I can now raise no further doubt as to the exactitude of the preceding numerical results, and I quite acknowledge, with M. Stas, that the atomic weights of bodies do not strictly present the simple relations which Prout's hypothesis would require.

But it is impossible for me to allow that it can be a simple effect of chance which causes nine at least out of these twelve bodies to have weights represented by numbers which only differ from entire numbers by quantities infinitely less than those which would have been foreseen by the calculation of probabilities. Indeed, the mean deviation which, for such a large number of bodies, ought to approach 0·5, is, on an average, only 0·003, even by taking chlorine into this general calculation; it is only 0·068 if this element is set aside as belonging, perhaps, to another group.

Nevertheless, it seems to me useless to enter into this discussion, for I could only repeat the observations which I had offered at the sequel of M. Stas's first memoir.

I shall only add that this question cannot be solved with very great probability till the atomic weights of most bodies are known to us with as much certainty as those which M. Stas has determined. But if, in these future determinations, there is found the same proportion of bodies whose weights approach entire numbers in such a remarkable manner, it seems to me impossible not to rank Prout's law with those of Mariotte and Gay-Lussac, and equally impossible not to admit the existence of an *essential* cause, by virtue of which all atomic weights ought to present simple relations, recognising, at the same time, *secondary* causes, leading to slight perturbations of these relations.

Action of Alkalies upon the Ferro- and Ferri-cyanides of Iron, by WILLIAM SKEY, *Analyst to the Geological Survey, New Zealand.*

IT is generally set forth in those chemical works which treat upon these substances that "their colour is instantly destroyed by alkalies," but from the results of a few experiments made upon them, it appears this statement requires some qualification.

Thus, if either of these compounds is treated with a very weak solution of caustic or carbonated alkali, the colour thereof receives such an accession in its intensity as to rival the colour of indigo blue.

If a solution of "Turnbull's blue" is employed, the change of colour is very marked, while the solution keeps as clear as before. If used for writing purposes, it gives an intense blackish-blue ink on drying, and which is of some permanency; the addition of a certain quantity of ferricyanide of potassium affords a bright green ink.

Like the aqueous solution of basic Prussian blue, these compounds are precipitated from their solution by the addition of alcohol or soluble salts, especially if these have strong affinity for water.

It appears that the change in the intensity of the colour is caused by the abstraction of a portion of the ferro- or ferri-cyanic acid, for if these compounds are repeatedly washed with water until nothing more is dissolved from them, the addition of the alkali in quantity only sufficient to produce these changes, immediately brings either of these acids into solution.

A great excess of carbonate of ammonia, by virtue of the action it exercises upon the oxides of iron, dissolves these blue compounds, forming with them pink or red solutions, which, when spread upon paper, are at first almost invisible, but gradually darken if an excess of ferricyanide has been used. The final colour is bright green.

These reactions appear both interesting and suggestive—interesting as affording other instances of indigo-blue-coloured compounds of iron, to add to those of the tannate, gallate, and phosphate, and suggestive as intimating the possibility that in all these ferri- and ferro-compounds of iron the metal is in the same state of oxidation as it is in these other salts above alluded to.

March 9.

Chemical Society.—The next meeting of the Society will be held on Thursday evening, at 8 o'clock, when the following papers will be read:—"*On the Basicity of Tartaric Acid*," by Mr. Perkin; "*On the Absorption of Vapours by Charcoal*," by Mr. J. Hunter; "*On the Reactions of Hydroiodic Acid*," by Mr. E. T. Chapman.

Paroxybenzoic Acid.—This acid has been transformed into protocatechuic acid by M. Barth. He operated on the various derivatives of paroxybenzoic acid—that is to say, the ethylo-, nitro-, bromo-, and amido-derivatives.—*Zeitschr. Chem.* 373.

REPORT ON THE

CHEMICAL LABORATORIES

IN COURSE OF ERECTION IN THE

UNIVERSITIES OF BONN AND BERLIN.

The Chemical Laboratories of the Rhenish Friedrick William University of Bonn.

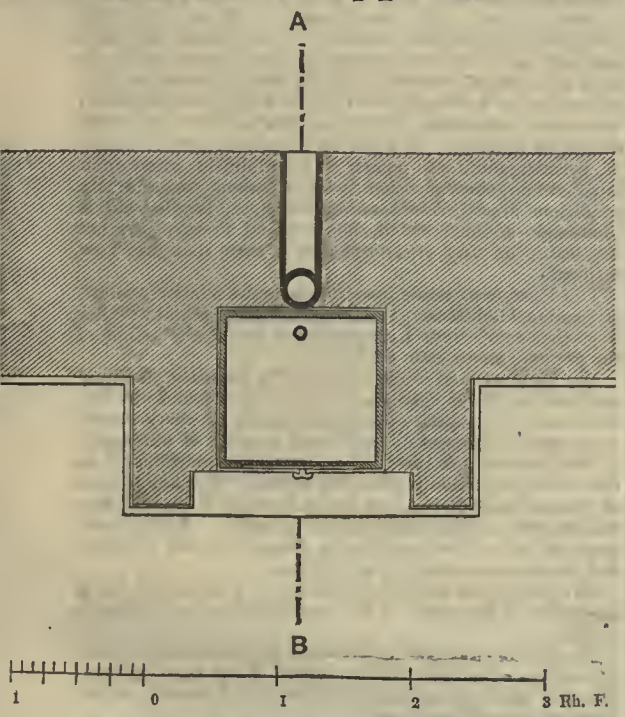
(*Continued from page 270.*)

A few words on the supply of air will complete this sketch. Under ordinary circumstances the niches will draw the air from the laboratories, and thus materially contribute towards their ventilation, and for this purpose the window-panes closing the front are not to be let down to the very base. To prevent, however, if many niches of a laboratory were simultaneously used, a return current in any one of the flues, a free supply of air is provided even whilst the fronts are hermetically closed. This proceeds directly from the external atmosphere by a curved earthenware pipe, the position of which is seen in both Figs. 12 and 13.

Fig. 13.

Evaporation Niche.

RIZONTAL SECTION ALONG THE LINE D E IN VERTICAL SECTION.



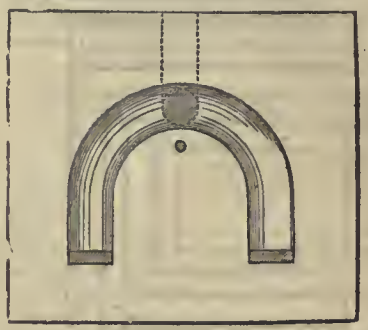
One end of this tube, hidden by a rosette, terminates in the outer face of the wall, the other lies flush with the smooth and regular cement slab on which the basement slab of the niche rests. In the lower face of this slab is a broad shallow channel in the form of a horse-shoe, communicating at the bend with the earthenware pipe, and at the ends with the niche, by means of vertical slits, similar in section to the groove itself, through which the air issues just behind the window-pane. Fig. 14 gives a view of the basement slab from below, showing the supply-pipe, the crescent-shaped channel, together with the two slits carrying the air up into the niche. The slits may be either partially or entirely closed by two lids of plate glass (shown in Fig. 11).

The front of the niche, as already mentioned, is closed by a strong pane of plate glass, the movement of which is regulated by counterpoises hidden within the pillars of the wooden frame, which, in elevation, is given in Fig. 15, representing the niche as seen from the laboratory.

Fig. 14.

Evaporation Niche.

Lower Surface of Basement Slab.



In the corners, between this wooden framework and the wall of the room, are fixed the pipes supplying the niche with gas, which enters a few inches above the level of the working bench from either side through porcelain tubes traversing the stone walls of the niche. From these tubes, visible in Figs. 11 and 12, the gas may be conducted by means of caoutchouc tubing to any apparatus in the niche.

The flues ascending from the niches can also be conveniently used for carrying off the vapours evolved on the working benches themselves. In many experiments the apparatus required is so complicated, or occupies so much space, that it cannot conveniently be fitted up in the niche itself. In such cases it is merely necessary to make the entire apparatus air-tight, and to connect its end by means of caoutchouc tubing with the interior of the niche. For this purpose the latter is provided with two other porcelain tubes passing through its walls near the roof, and visible in Fig. 12. The ends of these tubes, which project into the laboratory, are closed with corks when not connected with apparatus generating gas to be removed.

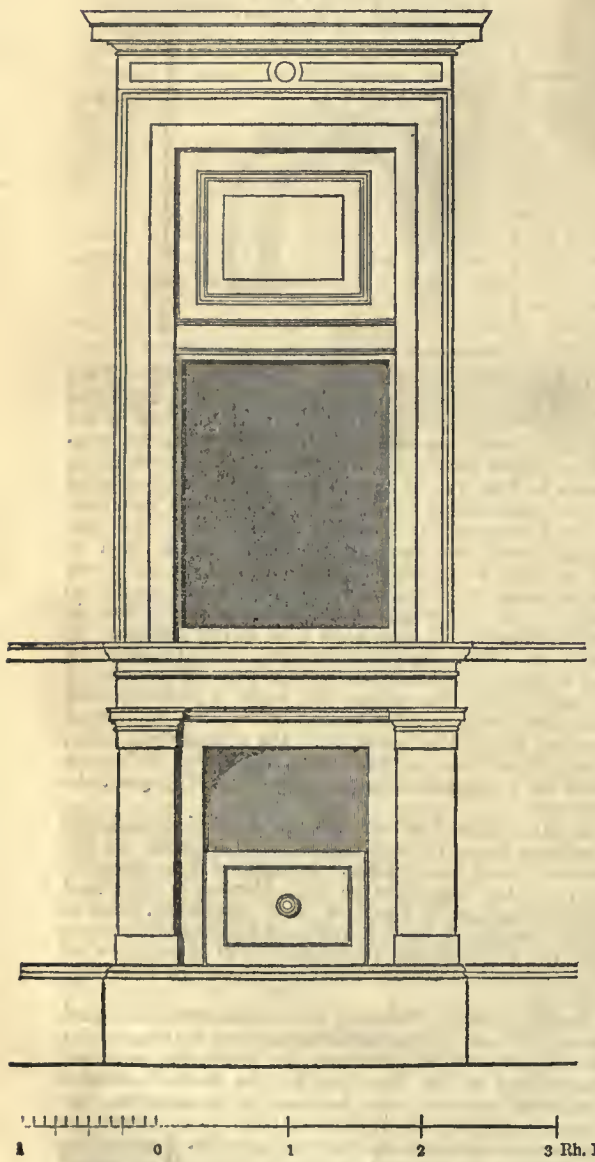
Lastly, it should not be left unnoticed that sandstone was by no means the material originally intended for the construction of these niches. Indeed, the three sides, the roof, and the base were to have been made of glazed earthenware, but the plan had to be abandoned, since, in spite of numerous trials, it was found impossible to procure from the works in the neighbourhood of Bonn slabs of the required dimension perfectly smooth and free from flaws and cracks.

Perhaps a better result may be obtained at the celebrated works of March, of Charlottenburg, where the evaporation niches for the Berlin laboratory, for which the construction devised by Mr. Neumann for the Bonn institution has served as a model, are in course of preparation. Be this as it may, the failure of the attempt to construct the niches in earthenware has suggested the idea of substituting glass for the material previously tried. With regard to cleanliness, resistance to the action of almost all gases, and even elegant appearance—more especially if the spaces between glass and wall be filled with plaster—this material leaves nothing to be desired. There are, however, some difficulties in the mode of joining the glass plates which have not yet been overcome.

The experiments on this new construction are still going on; their result, however, has been so far promising that in the Bonn laboratory only those niches, the completion of which was indispensable for the continuation of the building, have been made of sandstone. The glass casing,

should it prove practicable, could then be still adopted for the remainder of the niches.

Fig. 15.
Evaporation Niche.
Elevation.



At a later period the reporter may have an opportunity of stating what material has been found best suited for the construction of these niches.

A Narrow Escape.—At the works of the Magnesium Company, Manchester, owing to the recent floods in that part of the country, a very narrow escape from a tremendous explosion occurred. About 4 cwt. of sodium was stored in one part of the works, and here the water rose to within an inch of the mouths of the jars containing it. The roof had to be unslated to allow the men to get it out before any damage took place.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, December 6.

Professor W. A. Miller, *M.D., F.R.S., President, in the Chair.*

The minutes of the previous meeting were read and confirmed, and the library donations announced. The following gentlemen were ballotted for and duly elected Fellows of the Society, viz.:—A. C. Cook, Ph.D., Demonstrator of Chemistry, King's College, London; Henry Dircks, C.E., Whitehall Club and Bucklersbury; James Forrest, Ashburnham Road, Greenwich; William Huskisson, Gray's Inn Road; A. F. Marréco, Newcastle-on-Tyne, and J. Hancock Richardson, of the same place; Alexander Morrison Thomson, D.Sc., Sydney, New South Wales. The names of the following candidates were read for the second time, viz.:—John Broughton, B.Sc., Chemist to the Government Cinchona Plantation, Madras Presidency; Mr. Watson Smith, Analytical Chemist, 26, Portland Crescent, Manchester; and Mr. Walter Noel Hartley, Pathological Laboratory, St. Thomas's Hospital.

Mr. Ernest T. Chapman read a paper "*On a New Synthesis of Formic Acid.*" From a consideration of the results obtained by Mr. Thorp and himself, Mr. Chapman was led to believe that the action of bichromate of potash and sulphuric acid, and of permanganate of potash with the same acid, did not consist merely in the addition of oxygen or removal of hydrogen, but that, in many cases, hydroxyl was either substituted for hydrogen or superadded to the substance oxidised. The author finds that, by the action of permanganate of potash and sulphuric acid upon purified lampblack or other forms of carbon, under certain conditions described in detail in the paper, formic acid is produced—a result which, he ventured to say, was not explicable on any other hypothesis than that just now set forth.

The President made inquiries as to the relative amount of formic acid obtained; and Dr. Frankland asked whether any other compounds were generated during the action of the permanganate upon carbon.

Mr. Chapman, in reply, said that the quantity of formic acid produced was very small indeed; that which he had collected for examination was the result of many operations, and the process did not seem capable of extension. It was important to limit the amount of sulphuric acid to the exact proportion required to saturate the alkaline base of the permanganate, and he had satisfied himself that the lampblack itself contained no hydrogen. A very small quantity of carbonic acid was formed in the reaction, and throughout oxygen was evolved.

Mr. Newlands alluded to the fact of formic acid being generated by the action of hydrated alkalies upon carbonic oxide.

Dr. Muller referred to previous statements relating to the action of sulphuric and nitric acids upon carbon, whereby small quantities both of fixed and volatile carbon compounds were produced.

Dr. E. J. Mills desired information upon the mode of collecting the carbon—whether or not a paper filter was employed?

Mr. Chapman said he fused or deflagrated the lampblack with a minimum of saltpetre in order to effect its purification from hydrocarbons, then washed it by decantation, and collected in a funnel stopped with a plug of ignited asbestos. He had specially looked for carbonic oxide in the gas evolved from the permanganate, but could not find a trace.

Mr. Parkinson exhibited, and gave an account of, "*The Alloys of Magnesium.*" These were generally prepared by bringing magnesium wire into contact with the primary metals fused beneath a layer of salt, fluor-spar, or a mix-

ture of the latter with kryolite. None of the alloys offered any promise of practical employment, from the fact of their being invariably very brittle and easily tarnished. The only exception to this rule was the zinc alloy, which appeared to be permanent; whilst, on the other hand, the combinations of lead and bismuth were distinguished for the rapidity with which they were affected by the air. The author described the compounds which magnesium forms with phosphorus and arsenic, and called in question the accuracy of Mr. T. P. Blunt's statements relative to the black phosphide of magnesium.* At a red heat the metal decomposes even carbonic acid; and when mixed with fine sand and strongly ignited, a metallic silicide is formed, which disengages the spontaneously inflammable hydrogen compound by the action of water or dilute acids. Mr. Parkinson suggested the possibility of employing the magnesium amalgam in medicine as a substitute for *hydrarg. cum cretâ.*

Dr. D. S. Price doubted the expediency of attempting the production of an iron magnesium alloy in the manner described. Spiegeleisen, if not other kinds of cast iron, were said to contain traces of magnesium.

Mr. Tarner certified to the use of cast-iron vessels in the manufacture of magnesium according to Sonstadt's patent, the metal being distilled in a current of hydrogen.

Mr. Vernon Harcourt and Mr. Spillea spoke upon other points raised by the author in his communication.

Mr. R. H. Smith read a short paper "*On the Oxidation of Ethylic Benzoate.*" The author finds that benzoic ether is, by the action of bichromate of potash and sulphuric acid, simply resolved into benzoic and acetic acids. The ether was digested for several hours with a 12-per-cent. solution of the bichromate without any more than mere traces of gas being evolved. The acids formed were separated and recognised by their respective saturating capacities, as well as by various qualitative tests.

Mr. Chapman, at whose suggestion the experiment was undertaken, spoke of the permanent character of benzoic acid, and probably of all the other acids of this group, which, in respect to their resisting the action of oxidising agents, resemble the acids of the acetic series.

The President moved a vote of thanks to the authors of the several communications, and adjourned the meeting until the 20th inst., when a paper "*On some Reactions of Hydriodic Acid,*" by Mr. E. T. Chapman, will be read.

ROYAL SCHOOL OF MINES, MUSEUM OF PRACTICAL GEOLOGY.

A Course of Twelve Lectures on Chemical Geology, by Dr. Percy, F.R.S.

Lecture No. XI.

(Continued from page 272.)

The next substance we shall consider is vivianite, a compound of some interest. This vivianite is phosphate of iron. There is a species occurring in Delaware—a tribasic phosphate of iron containing water. It speedily colours when exposed to the air, assuming a blue tint. The interesting point is that this mineral is found in boggy ground, where animal remains exist, the phosphoric acid being derived undoubtedly from the phosphate of lime in the animal remains. Vivianite has been known to occur in fossil teeth. Then there are certain fossil shells in the Black Sea presenting phosphate of iron. You may also see bones taken out of the ground presenting a considerable quantity of this blue phosphate of iron. The condition required appears to be the long-continued action of water containing a salt of iron upon phosphate of lime, and there may be some secondary agents at work for aught we can tell. This compound is soluble to a certain extent in water, and more especially so by the aid of carbonic acid. There is no difficulty in accounting for its crystalline form. We can produce it crystallised, in fact, without much difficulty.

I may pass over the silicate of iron, except in reference to its formation as an accidental product in metallurgical operations. It has been stated that the silicate of protoxide of iron has been met with in Ireland, and I state that upon the authority of the late Dr. Thompson. I made inquiry about it some time ago, and got this specimen from a mineral dealer. It was said to come from the locality in which Dr. Thompson reported silicate of iron to be found, but on examining the specimen it appeared to be very like a slag, and therefore I regard the occurrence of silicate of iron in nature as very doubtful at present. There is another silicate, a blue or greenish silicate. Sand, when it is green, is supposed to owe its colour to the intermixture of silicate of iron. Silicate of iron seems to contain the oxides in two states, the protoxide and the peroxide, and though we have tried to ascertain the conditions we have not been able to do so. We can produce it by double decomposition. If we take a soluble silicate like silicate of soda or potash, and add it to a salt of protoxide of iron, we get silicate of iron of a green colour.

Now for one of the most important of the natural compounds of iron—the carbonate of iron. To the carbonate of iron we in a great measure owe our national prosperity. This compound abounds in nature. It consists essentially of one equivalent of carbonic acid and one of protoxide of iron. It contains no water. It occurs sometimes very beautifully crystallised indeed, and occasionally massive, forming large crystalline rocks, sometimes in masses, and sometimes in lodes or veins. We can produce it artificially in the amorphous state, as we have done here, with certain precautions—the absence of oxygen especially. Here is some which Mr. Smith has been good enough to make. We have taken some carbonate of soda and a salt of protoxide of iron, mixing them together in the solid form in a tube, and then closing the hole so as to exclude the air. The carbonate of iron has been gradually formed. It is white at the bottom, but a little air has got in and darkened the surface. It is a substance which becomes speedily acted upon by oxygen—the oxygen of the air to wit. We cannot expose this carbonate of iron which we have formed without its being further oxidised with the elimination of carbonic acid, just as the ore at Hastings is decomposed and converted superficially into oxide of iron combined with water. This furnishes us with a clue to the occurrence of this compound in nature. We have it abundantly in our coal measures. It is perfectly certain that the conditions under which it was formed were such as to exclude oxygen. That is perfectly certain, or it would have been decomposed. But although it is so easy to act upon carbonate of iron when thus prepared, it is possible to produce a specimen of carbonate of iron which shall not be so easily acted upon. Now, here is a specimen—not chemically pure, but essentially composed of carbonate of iron. Though long exposed, it has undergone but very slight decomposition. After a time it generally becomes a little brown on the surface by exposure.

Carbonate of iron has been artificially obtained crystallised. Senarmont so prepared it in the form of a greyish white sand, hardly attackable by dilute acids. A great deal depends here upon the state of aggregation of a body. You may get the same substance, chemically, in very different states of aggregation: in one it shall be easily acted upon by an acid, in another with great difficulty, or hardly at all. Well, that is the case, to a certain extent, with this carbonate of iron. If we obtain it in the simple way I described, it is easily acted upon; if we obtain it at a high temperature, it is much more difficultly acted upon. Senarmont informs us that that which he obtained remained nearly unchanged in dry air, and very slowly acquired a pale brown colour in moist air. He made it by exposing a mixture of sulphate of protoxide

* Vide *Journal of Chemical Society*, May 1865, p. 106.

of iron—that is, common green copperas—and carbonate of soda, or of protochloride of iron and carbonate of lime, in hermetically sealed glass tubes—in the first instance to a temperature of 150° Centigrade, or beyond, and in the other case to a temperature of from 130° to 200°, during from 12 to 36 hours. The salt was darker in colour and more permanent in the air the higher the temperature employed and the longer its duration. He says the form of the crystalline mass was distinctly rhombohedral. There is no difficulty in accounting for the conditions under which carbonate of iron may have been thus formed in nature. Probably here hydrothermic action may have played a very important part. There is a carbonate of peroxide of iron, but it possesses very little interest for us. It was doubted whether it did exist, but it has been shown of late that there is such a thing, though it is of a very transient character.

Carbonate of iron in nature is called spathic ore. It is seldom pure, and generally contains carbonate of lime, carbonate of magnesia, and carbonate of manganese.

The solubility of carbonate of iron in nature is a point which I think we should bear in mind. Bischoff has made observations upon this subject. He says that 10,000 parts of pure water dissolved about 28 parts of precipitated carbonate of iron such as you have here. The precise quantity is 28·09. The same quantity of water dissolved of the natural carbonate only 6·0755 parts. You may call the quantities dissolved 28 parts and 6 parts. He says the mineral is dissolved more rapidly by the application of heat, but at the same time it is quickly decomposed. There is no doubt about the solubility of carbonate of iron being greatly increased by carbonic acid, and a short time ago there was a patent taken out for the preparation of artificial chalybeate water on this principle. The carbonate of iron was dissolved in water containing a large amount of carbonic acid. On exposure of the solution to the air, a rusty appearance was produced, owing to a brown precipitate being thrown down.

Now as to the impure carbonates of iron—for these are the most important minerals with which we have to deal. We have the sparry iron ore occurring in this country. We have very fine specimens of it in Somersetshire. I have seen it at Alaton Moor, in a small lode there. It occurs also in other parts of England. That at Alston Moor contains carbonate of lime, which reduces its value. In Styria there are enormous masses of this sparry iron ore, and also at Stalberg, in Prussia. It has been the source of iron from time immemorial. At Siegen, in Prussia, it occurs in lodes—that is, fissures of the earth filled up with it—not in beds and masses. It also occurs at the same place in slate. Here is a specimen from Alaton Moor. It does not contain much ore—only 21·7 per cent., but it might be valuable for its lime as well as [illegible]s iron. It has been used as a flux in glass furnaces with [illegible]ntage, both the lime and the iron being serviceable, [illegible]on being reduced and the lime acting as a flux. We [illegible]reat quantity of the amorphous and non-crystalline [illegible]s of iron. All the iron ores of our coal-measures [illegible]s class. In the museum above you may see [illegible]of almost every kind in the kingdom. This [illegible]ore is a characteristic example. There it is [illegible] of hardened clay, of a greyish-brown colour. At a later [illegible]mes much lighter than that, and sometimes of stating wh[illegible], this colour being simply owing to the inter[illegible] the constructional or bituminous matter, and nothing more. [illegible] find great nodules in these cracks, which [illegible]r with sparry iron ore in distinct crystals.

A Narrow [illegible]nesium Company, in coal-measures either in continuous in that part of the these nodules being distributed, and tremendous explosi[illegible]ng sometimes no larger than a penny was stored in one pa[illegible]s as large as a man's head, or very rose to within an inch consist essentially of carbonate of it. The roof had to b[illegible] always, without exception, a little it out before any damage[illegible]onate of magnesia, carbonate of protoxide of manganese, and phosphoric acid. The phosphoric acid is very variable in proportion, and the quantity is sometimes very small. They contain also a little sulphur in the form of iron pyrites, and sometimes as a sulphate—perhaps sulphate of lime. Potash or soda is invariably present—sometimes one, sometimes the other, sometimes both, but potash generally. Silica and alumina are present in combination, as silicate of alumina—fire clay in fact. If you take one of these ores, reduce it to powder, and act upon it by hydrochloric acid, so as to remove everything soluble, you get a residue which is fire clay—good fire clay. Then there is generally water in combination, and there may be hygroscopic water. There is also coaly matter, as in the blackband ironstone, which was brought into use in this country in the year 1806 by Mr. Dick. Before that time its value was not recognised. I have pointed out to you how in these iron ores we sometimes get further metalliferous matters—copper pyrites, sulphide of nickel, sulphide of zinc or blende, and so on, but there is one which I have not mentioned, met with in the blackband iron ore; it contains a notable quantity of silver, about half an ounce to the ton. It is a singular thing we should find silver there. There is no doubt that it must have gone down from water. It is diffused over a pretty large extent. Then, I have no doubt that there is always titanium. We always find titanium in the products of our blast furnaces, but attempts to find it in the iron ore have not been successful, though of late we have approached nearer to success than we ever did before.

These clay iron ores differ not only in compactness and colour, but also in their intimate structure. I do not know any that do not present an oolitic structure. If there are any, they are very few at all events. We shall find that the clay iron ores in their formations are very distinctly oolitic in structure—like the Cleveland iron ore to wit.

For the reasons previously given, we conclude that all these impure carbonates of iron have undoubtedly been thrown down under conditions involving the absence of oxygen. Perhaps there was an abundant evolution of carbonic acid at the time—nothing more likely. There may have been carbonic acid, carburetted hydrogen, and perhaps something else besides. Suppose a bed of coal to have been first deposited, and upon this bed of coal a quantity of clay, and then suppose the iron to be deposited, the whole having gone down or been submerged gradually. We know perfectly well the coal would be in a state of decay—nay, it is in a state of decay even now. Thus the gases I have mentioned would come bubbling up from the coal below, through the mass above, and forming the carbonate of iron. But, however this substance may have been obtained, it is certain that oxygen could not have been present, and that is the point on which I am anxious to fix your attention especially.

I may state that these ores contain on the average about 33 per cent. of iron. The South Staffordshire ores may be taken as a fair typical example of this class of compounds. Sometimes we find 41 per cent., and sometimes the proportion is as low as 26 per cent. When we get what is called a very lean clay iron ore, it is only fit for making Roman cement, common Roman cement being made, in fact, from such ores. There is a singular variety to which the name of brass was given. It was thrown aside on the pit mounds in South Wales by experienced coal workers as apparently worthless. It turned out to be a good iron ore, and realises now many shillings a ton. Here is a specimen of this substance. It is very important that gentlemen interested in these matters should see these samples with their own eyes. They then get impressions which they do not readily lose, and which they cannot get any other way. This clay contains bituminous matter. Now who would take it to be iron ore? Instances of this sort are continually turning up, showing the importance of accurate scientific knowledge. Some of our

practical men affect to despise science, though happily during the last 20 years there has been a great revolution in this respect, and many mining men now possess a large amount of scientific information which they turn to practical account not only for their own benefit, but also for that of their employers. Only quite recently I heard of a valuable tin ore being thrown away largely as worthless through its real character not being recognised. Here in the museum you can have an opportunity at all times of seeing these specimens arranged; but there is another kind of collection which I think of great importance, such as a small home collection, which ladies and gentlemen who are interested in mineralogical subjects should always keep. You should look at these things again and again, and study their appearance until you have thoroughly become master of them. I should strongly recommend the practice, especially among youths, of the formation of little collections of this kind. One never knows how he may require the information which these will afford him. His knowledge may be called into exercise either in this country or elsewhere in different parts of the world.

The Cleveland iron ore is highly oolitic in structure—some of it beautifully so, consisting of little roundish grains, covered with a brownish coating, and cemented with a greyish-green matter. It is a carbonate of iron containing about 30 or 40 per cent. of metallic iron, but it contains also free silica, thus showing that the silica which was separated by the action of acid from that ore has been in combination with iron ore in two states—protoxide and peroxide. We get gelatinous films produced by the action of the acid, and we get also distinct crystals of anatase, which is a titanium mineral. The crystals were very closely examined by Professor Miller, of Cambridge, and he recognised distinctly their crystalline form. I do not think the occurrence of anatase had been previously recognised.

Our information with regard to the conditions of the formation of these iron ores in coal measures is scanty. What I have said about their mode of formation applies in a great measure to the Cleveland iron ore. We find it in coal measures, in lias, in oolite, in the wealden down at Hastings, and in the tertiary.

Some time ago, when I was in South Wales, I saw a large quantity of iron ore, which had been dredged up by fishermen at the Isle of Wight, sold at Cardiff for ten shillings a ton. I saw many truckloads going up to some large iron works there.

I should recommend you to examine the specimens showing the conversion of carbonate of iron into peroxide by gradual weathering action. Here is a very characteristic specimen. We have here the same structure as in the carbonate, but the composition is entirely different. It is here converted into brown peroxide of iron. Now, we should naturally expect, in a bed of great depth, that we should get the carbonate deeper than the peroxide; and that is the fact. I do not say that it is necessarily so, but the deeper we go the more likely we are to get the carbonate.

The next metallic substance to which I must devote attention is copper. Now copper is a very important mineral, and it occurs in various forms in nature. I cannot dwell upon the chemical properties of copper, but must give you credit for information on those points. It crystallises in the cubical system, and the crystals are sometimes well defined in metallurgical operations. We have specimens of octahedra of copper obtained by fusion, but they are exceptional, but after electrotype processes we get it well defined sometimes; and if you compare the little foliated pieces of natural copper with some of the copper crystallised artificially by voltaic agency, you cannot hesitate in coming to the conclusion that both have been produced under essentially the same conditions—namely, by voltaic agency—in the one case in the laboratory of the chemist, and in the other case in the laboratory of nature, as it is called. Copper occurs abundantly at Lake Superior, but it is too pure to be profitably worked. It could be obtained more easily if mixed with sulphur. It cannot be blasted owing to its extreme toughness. It can only be cut by the slow operation of chisels, and that involves great expense.

Now, let us see how we find copper in nature. It is found in mesotite in Siberia, and in one of the Faroe Islands; and it is found in amygdaloidal trap in various parts. Now, trap is an igneous rock—a rock which has been melted. It is perfectly certain that copper could not have been there at that time, because the copper and the trap have very widely different specific gravities, and if the copper had been present when the trap was melted, the copper would have gone to the bottom. We see that every day in our copper furnaces. Well, then, the copper in this case must have got into the rock, after the rock was fused, by the action of copper salts, and the deposition of copper by electrical or other agency. The Lake Superior copper is likewise found in trap, intersecting sandstone, and it is very curious that in the Lake Superior copper deposit we find silver.

Now I would beg particular attention to this. You see how we get important conclusions from apparently trifling points. There are those two metals together—metallic silver and metallic copper. They are not alloyed, but they are in close proximity, and sometimes singularly intermingled together. The silver is silver, and does not contain copper; and the copper is copper, and does not contain silver. Now, if these two metals had been melted together, they would have been alloyed, and when once alloyed they would not have been again separated. That shows that this copper and silver could not have been melted together, and must therefore have been deposited in some other way, probably by voltaic agency. That is a very important point. Then we get sometimes, from Lake Superior, very characteristic specimens of crystallised carbonate of lime, containing copper crystals in the interior. Copper is found in pseudomorphs after red oxide of copper, and also after aragonite itself. These pseudomorphs are false forms. I have pointed out to you what was meant by them. For instance, a crystalline matter disappears and leaves behind it a mould, which gets filled in by some other substance, and this substance then gets a crystalline form not belonging to itself, but belonging to the substance which was originally present and formed the mould. Or a substance may disappear gradually and be replaced by another body, crystal by crystal, and so we may get a pseudomorph in a different way. I had a pseudomorph of metallic copper some time ago. There is little doubt that it was produced by the decomposition of oxide of copper by some reducing agent—possibly by some reducing gas, but that is not certain at present. In the majority of cases in which we meet with metallic copper in nature, undoubtedly that copper has been thrown down from solution, and most probably by the agency of the voltaic current.

The red oxide of copper is one of the most interesting ores of copper, and one of the most interesting and beautiful compounds of that metal. It occurs crystallised in the same system as metallic copper itself—namely, the cubical—and we have it in the octahedron, or in the rhombic octahedron. I will invite your attention specially to one of the cases up yonder, in which you will find beautiful specimens of this rare mineral converted into malachite, from near Lyons. We obtain it sometimes in metallurgical products, occasionally well crystallised. There is no difficulty about that. Then we can get it in the wet way by boiling common cane sugar with sulphate of copper. Fine crystals may be thus obtained. Becquerel tells us that it may be got by exposing a piece of metallic copper in a solution of nitrate of copper to a temperature of 400° Centigrade, under a pressure of four or five atmospheres. No doubt it may be obtained in other ways.

Here is a quantity of chloride of copper into which a piece of metallic lead was immersed some years ago. It has not been opened since the year 1858. A variety of compounds have been produced here. Here is another illustration—a sort of little artificial mine. The action has been going on for five or six years. We had here a piece of lead placed in another salt of copper—nitrate of copper. Nitrous oxide was developed for a long time, but I do not know what compounds have been formed—no doubt half-a-dozen things. I present these to you in illustration of the singularly complicated local reactions which have occurred, and do occur still, undoubtedly, in our mines. Here, again, is some chloride of copper with some common salt, chloride of sodium. We get here metallic copper and chloride of copper and chloride of sodium, and the whole surface of this is covered with a beautiful deposit of red oxide of copper. The red oxide of copper in nature very often occurs in association with metallic copper. We have numerous specimens of that in the museum above. Occasionally we may take a specimen which is apparently green malachite, but on examining it we may find in the interior red oxide of copper, and in the middle of that we may meet with metallic copper. I have seen the red oxide of copper and the malachite around a nucleus of metallic copper. I could point out to you a singular illustration of this in the collection of the British Museum. It is among the things brought over by Mr. Layard, and it is the result of an action which has been going on two or three thousand years. There is a portion of a vase, which happened fortunately to be broken, which is quite green on the exterior—in fact, it is green malachite, and underneath is a glass coloured with red oxide of copper. I obtained a piece of that glass, and had it cut for a microscopic object. It is beautifully coloured, and resembles porphyrine. Red oxide of copper is one of the prettiest objects you can see in mineralogical collections. Unfortunately, these fine specimens from Chessy, which have been in great request, are not very abundant.

NOTICES OF BOOKS.

Lecture Notes for Chemical Students. By Professor Frankland, F.R.S. London: J. Van Voorst. 1866.

[second notice.]

We cited, in speaking of the graphic representation of chemical substances, a mode of writing the formula of pyrites which may be taken to represent the disposal of the active bonds of that substance. Now there are two minerals, pyrites and marcasite, both expressed by the formula FeS_2, and yet differing in many of their physical properties, such as hardness, specific gravity, and crystalline form. Dr. Frankland gives for pyrites the graphic formula—

We may, therefore, reserve the other mode of graphically representing the bisulphide of iron for the more oxidisable mineral, marcasite—

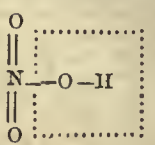
Any one who has carefully studied the peculiarities of pyrites and marcasite will readily perceive the facilities which the graphic notation affords for representing and even explaining these and similar peculiarities.

In addition to the points already indicated, these lecture notes are particularly distinguished by the very free use made of graphic formulæ. In these every atom of each element present in a compound is represented by a separate symbol. Although the author adopts many compound radicals in his symbolic formulæ, these radicals do not at first sight appear as such in the graphic notation. But the following examples of the two methods of notation will sufficiently show how they both express the same views; we must premise that these radicals are expressed in an abbreviated form, as follows:—

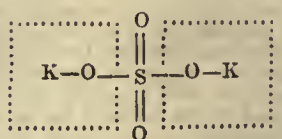
Hydroxyl (HO) = Ho
Potassoxyl (KO) = Ko
Zinkoxyl (ZnO_2) = Zno″

We now cite the names and formulæ of several common salts into which these groups enter by means of the unsatisfied or unlinked bonds of their dyad element, oxygen. In the graphic formulæ we mark the position of the radicals by dotted lines.

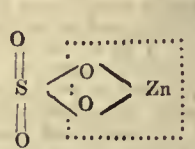
Nitric acid NO_2Ho



Potassic sulphate SO_2Ko_2



Zincic sulphate SO_2Zno''



Some of the most interesting graphic formulæ in this volume are those assigned to minerals. We cannot but hope that the new light thrown upon these most instructive compounds will awaken an interest in chemical mineralogy. A careful study of many of the formulæ adopted by Dr. Frankland for some of the rather rare and less intelligible minerals has convinced us that much labour and thought must have been expended upon this branch of the science. Minerals are so often contaminated with intruding substances, and are so often mixtures of allied or isomorphous minerals, that it is very difficult to assign to them reasonable formulæ. We believe that our author has been unusually successful in accomplishing this hard task, sometimes, it may be, by a happy guess, but rather, as a general rule, by the aid of those new views on the functions of the elements which he has so thoroughly expounded. The alarmingly complicated silicates have not deterred our author from attempting their graphic portraiture; witness the representation of saponite and lepidolite on the plate facing page 178. With a few of these mineral formulæ, however, we venture to feel a little dissatisfied. Chloropal, for example, is represented as a *ferric* trisilicate, although it invariably contains iron in the *ferrous* condition; for the powdered mineral, thrown into acidulated potassic permanganate, instantly decolorises it. Then again, in the expanded formula for chloropal given on the plate facing page 103, the oxygen atoms are represented as sometimes dyad, somtimes triad, and sometimes tetrad. This surely must be a slip of the lithographer's pen, introducing by mistake a series of unnecessary bonds between some of the oxygen atoms. The graphic formulæ of the basic and normal sulphates are particularly admirable; we can here do no more than direct attention to those given on the plates facing pages

177, 187, and 194. Were we to attempt to point out in detail all the interesting portions of the book before us, we should, in fact, find some difficulty. The whole work, from beginning to end, is worthy of the most attentive perusal and the most careful study. We close the book with our pleasant anticipations on taking up the volume more than fulfilled by its perusal; we close it, moreover, with the intention of opening it over and over again. We will not now offer any further remarks concerning the merits of the volume; we heartily recommend our readers to study it for themselves.

The Principles and Practice of Photography familiarly Explained. By Jabez Hughes. Seventh Edition. London: Simpkin, Marshall, and Co.

A new edition of this excellent work is sure to be welcomed by all photographers, for there are few who may not find something to learn from it. A good deal of new matter will be found, for which the author has gained space by omitting many of the less used dry-plate processes, while giving a more detailed account of the two most popular of these—viz., the tannin and the collodio-albumen processes. The third part contains many papers likely to be of service to advanced photographers, dealing with such subjects as the construction of glass houses, the use of the solar camera, &c.

CONTEMPORARY SCIENTIFIC PRESS.

[Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts or full translations of the more important papers here announced will appear in early numbers of the Chemical News.]

Poggendorff's Annalen. No. 8. October.

"*On a New Method of Measuring the Velocity of Sound in Gases*," by J. B. Zoch.—"*Optical Researches: 4. On the Elliptical Polarisation of Light by Reflection from Metallic Surfaces*," by G. Quincke.—"*On Lullin's Experiments and on Lichtenberg's Figures*," by A. von Waltenhofen.—"*On Observing the Vibrations of Sounding Plates by Reflection*," by A. Kundt.—"*On some Peculiar Cases of the Production of Sound by Flames*," by the same author.—"*On the Radiant Heat which accompanies Fluorescence*," by V. Pierre.—"*On the Tangent Photometer*," by F. Bothe.—"*On the Theoretical Calculation of the Magnifying Power of Microscopes*," by Arndt.—"*On the Crystallisation of Sulphide of Sodium*," by H. Finger.—"*On Mohr's Theory of the Formation of Hail*," by A. Krönig.

No. 9. October.

"*On some Peculiarities connected with the Formation of Twin Crystals of Pericline*," by G. Rose.—"*An Experimental Proof of the Expansion of Solids under the Influence of the Galvanic Current, independently of the Heat produced by the Action of such Current*," by E. Edlund.—"*Optical Researches: 5. On the Manufacture of Metallic Mirrors*," by G. Quincke.—"*On the Absorption of Radiant Heat by Dry and Moist Air*," by H. Wild.—"*On the Influence of the Interposition of Glass Tubes in the Galvanic Circuit*," by K. W. Knochenhauer.—"*On the Use of Perchloride of Iron in Galvanic Batteries*," by A. von Eccher.—"*On the Capacity for Heat of various Soils and its Influence on Vegetation, together with some Critical Remarks on the Methods of Estimating the same*," by L. Pfaundler.—"*On the Perforation of Tinfoil by the Electric Spark*," by W. Hankel.—"*On the Ebullition of a Fluid when in Rotary Motion*," by A. Mousson.—"*On a Metcorite found at Tamentit, Africa, described by Gerhard Rohlfs*," by A. Sass.—"*On a Shower of Meteors described by Captain Cook*," by W. H. Miller.

Kunst und Gewerbeblatt. Nos. 8, 9. August-September.

"*On Disinfection as a Precautionary Measure against the Spread of Cholera*," by M. von Pettenkofer.—"*On Amber*," by Buff.—"*Practical Observations on certain Mineral Colours*," by E. Dieterich.—"*On the Results of Ozonometric Observations*," by the same author.—"*On the Preparation of Metals in a State of Fine Subdivision by Amalgamation*," by J. Fuchs.—"*A Composition for Gilding Porcelain*," by H. Reinsch.—"*On the Poisonous Nature of the Colours used for Colouring Slate Pencils*," by the same author.

NOTICES OF PATENTS.

Utilising the Residue from Chlorine Gas. William Francis Deane, Farnworth. (Provisional protection only.) Dated March 13,

The patentee proposes to take the residuum liquor arising in the manufacture of chlorine from oxides of manganese, and treat roasted iron pyrites containing copper therewith, the chemical action of which is as follows:—The liquor containing chlorides of iron and manganese and free acid dissolves copper and iron contained in the pyrites, which becomes added to the metals already held in the solution; now submit this liquor or solution to the reducing action of metallic iron, either in the form of plates, rods, or otherwise, upon which the copper is deposited in a metallic state, and thus the copper is extracted from the liquor. The liquor thus freed from copper may now be neutralised with carbonate of lime, or other alkaline earth; the remaining metals in the neutralised liquid may then be either precipitated with milk of lime, and either the whole or a portion of the iron may be separated first from the manganese by contact with carbonate of lime or other carbonated alkaline earths, and the manganese still in solution may be precipitated and again treated by any well-known process for the production of chlorine. If desired, this separation of the manganese from the solution may be made previously to the depositing or separation of the copper therefrom by the same treatment of carbonate of lime, by which process the manganese remains in solution as chloride of manganese, and the metals of iron and copper are precipitated as carbonates to be afterwards brought into solution by an acid from which the copper is extracted by the immersion of iron plates or rods.

The liquor obtained, after contact with the pyrites, can be neutralised by an alkaline earth or carbonate thereof, and the chloride of manganese in solution be precipitated and utilised, and the precipitates of carbonates of iron and copper may be dissolved by an acid, and the copper obtained in the form of sulphuret by treatment with an alkaline sulphuret or sulphuretted hydrogen, which last result is oxidised and brought into the form of sulphate of copper.

MISCELLANEOUS.

The Cattle Plague.—Fresh outbreaks of cattle plague are occurring in Lancashire, Yorkshire, and Cheshire. There can be no question that this recrudescence of the disease in counties from which it had been effectually stamped out is of grave importance, and more especially at this period of the year. The farmers are now gathering the cattle into their sheds. Whilst cattle are in the fields the means for preserving them from the plague are greatly facilitated by the ease with which they are separated, but now that they are being taken for the winter into sheds, previously the seat of this peculiarly insidious and active poison, the danger of infection of the herds is considerable, unless the most careful precautions have been taken for the thorough disinfection of these sheds. The manner of

best effecting this is clearly pointed out by Mr. W. Crookes, F.R.S., in his able report to the Cattle Plague Commissioners on the subject. He recommends that every shed and all parts of the shed should be first washed, and then washed down with a hot solution of carbolic acid water, to the strength of one per cent. of acid in the water; then that the sheds should be closed, crevices stopped, and the interior fumigated by burning a roll of sulphur upon hot coals in a shovel. The total expense of this need not, he says, exceed a few shillings. The operation is one of the greatest simplicity; and by this we might probably guarantee ourselves against a recurrence of serious disasters. The caution is one which is certainly timely, and, we hope, will not be wasted. Farmers may think that six months' disappearance of the disease, while their cattle have been in the fields, renders a return of the pestilence unlikely in their sheds, but it has, we believe, been proved that the germs of the poison may retain their vitality for six months, and it is highly probable that they may do much longer.—*British Medical Journal.*

The Benevolent Fund of the Pharmaceutical Society.—We have been requested to announce that a public dinner will be held at Willis's Rooms on Wednesday, February 20 next, for the purpose of obtaining donations and subscriptions and enlisting general sympathy on behalf of the Benevolent Fund. All the leading firms, wholesale and retail, town and country, have consented to become stewards, and it is to be hoped that this excellent Institution will derive as much benefit on this occasion as it did at the like festival in 1848. Few offshoots of the Pharmaceutical Society deserve more encouragement from members, associates, and friends.

Composition and Quality of the Metropolitan Waters in November, 1866.—The following are the Returns of the Metropolitan Association of Medical Officers of Health:—

Names of Water Companies.	Total solid matter per gallon.	Loss by ignition.*	Oxidisable organic matter.†	Hardness.	
				Before boiling.	After boiling.
Thames Water Companies.	Grains.	Grns.	Grains.	Degs.	Degs.
Grand Junction	21·33	1·00	0·76	14·5	6·5
West Middlesex	21·31	1·00	0·84	14·5	6·0
Southwark & Vauxhall	21·33	2·08	1·68	15·0	6·0
Chelsea	21·57	1·50	1·32	14·5	6·5
Lambeth	21·67	1·86	1·43	14·5	6·0
Other Companies.					
Kent	27·00	0·40	0·28	18·0	9·5
New River	19·98	0·69	0·52	15·0	5·0
East London	22·69	0·99	0·72	15·5	7·5

* The loss by ignition represents a variety of volatile matters, as well as organic matter, as ammoniacal salts, moisture, and the volatile constituents of nitrates and nitrites.

† The oxidisable organic matter is determined by a standard solution of permanganate of potash, the available oxygen of which is to the organic matter as 1 : 8; and the results are controlled by the examination of the colour of the water when seen through a glass tube two feet in length and two inches in diameter.

As is usual at this season of the year, the amount of organic matter in the water is larger than at other times. It is entirely of a vegetable nature.

H. Letheby.

The Virtues of Borax.—The excellent washerwomen of Holland and Belgium, who "get up" their linen so beautifully white, use refined borax as a washing powder, instead of soda, in the proportion of one large handful of powder to about ten gallons of boiling water. They save in soap nearly one-half. All the large washing establishments adopt the same mode. For laces, cambrics, &c., an extra quantity of the powder is used; for crinolines, requiring to be made stiff, a strong solution is necessary. Borax, being a neutral salt, does not in the slightest degree injure the texture of the linen. Its effect is to soften the hardest water, and therefore it should be kept on every toilet table. To the taste it is rather sweet; it is used for cleaning the hair, is an excellent dentifrice, and in hot countries it is used, in combination with tartaric acid and bicarbonate of soda, as a cooling beverage. Good tea cannot be made with hard water. All water may be made soft by adding a teaspoonful of borax powder to an ordinary-sized kettle of water, in which it should boil. The saving in the quantity of tea used will be at least one-fifth.—*Med. and Surg. Rep., from Druggists' Circular.*

Meetings for the Week.

Tuesday, December 18.
Pathological Society, 8 p.m.
Ethnological Society, 8 p.m.
Anthropological Society, 8 p.m.

Wednesday, December 19.
Society of Arts, 8 p.m.
London Institution, 6½ p.m.

Thursday, December 20.
Royal Society, 8½ p.m.
Linnæan Society, 8 p.m.
Chemical Society, 8 p.m.

Friday, December 21.
Philological Society, 8 p.m.

ANSWERS TO CORRESPONDENTS.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. *Private* letters for the Editor must be so marked.

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

A. W. Wilson, Ulverstone, wishes to know the present address of a firm of analytical chemists, "Evans and Jones."

A Druggist.—Ammonia is not an uncommon impurity in commercial phosphoric acid. Mr. Parkinson has found as much as 5 per cent. of ammonia in some samples.

F. A. W.—You have given too little information to enable us to draw any inference from the experiments.

J. S. shall receive an answer by post.

A Constant Reader will find a complete table of symbols and atomic weights, according to the different notations, at p. 96 of our tenth volume.

Photo.—Santonine is converted into photosantonic acid by exposure to light. It is probable that this reaction is capable of practical application in photography.

Peter X.—You will find M. Delenda's paper on the discovery of ancient remains in the new volcanic islands at p. 732 of the current volume of *Comptes Rendus.*

J. Wilson.—Nitrate of hydrogen is *not* a very rare or expensive chemical—in fact, it may be considered an article of commerce. Its common name is nitric acid or aquafortis.

The Ethics of Journalism.—The compromise which some journals make so as to meet, at the same time, their views of literary honesty, and their desire to appear original before their readers, is sometimes very amusing. Thus a *Magazine* last week prefaced an abstract of Mr Spiller's letter which recently appeared in our columns with the words, "*A correspondent* writes to a *contemporary.*" . . . Our friend, the editor of the *Magazine* in question, is informed that if he has conscientious scruples against mentioning the Chemical News when he fills up with our paragraphs, he is quite welcome to appropriate them without acknowledgment.

B. N. is desirous of obtaining an appointment as demonstrator in chemistry or analyst to a manufacturing company, either at home or abroad: he would prefer Australia. We are not acquainted at present with any such opening; but it is very probable that an advertisement would afford the means of bringing his requirements before those who may require such services.

A Student in Chemistry.—It is unreasonable to expect a 50-cell Grove's battery to keep in good order after continuous work for six hours. From 1 to 1½ hour is the longest time that a battery ought to be kept in uninterrupted action; after that time the heat becomes so great, and the action so violent, that the platinums are liable to become red-hot and melt. The violent action occurring in some of the cells immediately they were charged probably arose from bad amalgamation or the presence of nitric acid in the sulphuric acid. The action ceased after six hours' work, obviously because the acids had become saturated.

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THE

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AND

Journal of Physical Science.

Edited by] [*Wm. Crookes, F.R.S.*

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SCIENTIFIC AND ANALYTICAL CHEMISTRY.

On the Separation of Antimony and Arsenic, by H. Pellet *and* John Clark.

In 1843 Jacquelain found,* while studying the comparative reactions of antimonuretted hydrogen and arsenuretted hydrogen on different metallic salts in solution, that among others nitrate of silver was reduced. This reaction has been employed by different chemists for detecting the presence of antimony or arsenic in cases of poisoning, and not long ago Houzeau† described a process for estimating the arsenic contained in the hydrochloric acid of commerce, which was based on the fact that when arsenuretted hydrogen was made to pass through a dilute solution of nitrate of silver, a quantity of silver was reduced corresponding to the amount of arsenuretted hydrogen which had passed through the solution, and that the quantity of silver reduced could readily be determined by titrating the solution before and after the operation.

The following is a simple process for separating antimony and arsenic when they occur together in solution. It is based on the actions which antimony and arsenic in the form of antimonuretted and arsenuretted hydrogen exert on a dilute solution of nitrate of silver:—

The action of antimonuretted hydrogen, as we have verified, may be expressed by the formula—

$$3AgONO_5 + SbIH_3 = SbAg_3 + 3HO + 3NO_5.$$

The action of arsenuretted hydrogen on the nitrate of silver is entirely different, and may be represented by the following formula, which we have also verified:—

$$6AgONO_5 + AsH_3 = 6Ag + AsO_3 + 6NO_5 + 3HO.$$

From these reactions it will not be difficult to see how a separation may be effected by means of nitrate of silver. To effect the separation it is sufficient to conduct the mixture of arsenuretted and antimonuretted hydrogen, produced in Marsh's apparatus, with pure zinc, water, and hydrochloric acid, into a tube containing a moderately dilute solution of nitrate of silver. Every trace of arsenuretted and antimonuretted hydrogen is absorbed, all the antimony is precipitated with the reduced silver, and all the arsenic is contained in the solution as arsenious acid. The presence of arsenious acid may easily be detected by adding ammonia, drop by drop, to the filtered solution till the free nitric acid is neutralised, when a yellow precipitate of arsenite of silver forms, which is soluble in an excess of the precipitant; by removing the excess of nitrate of silver with hydrochloric acid, and precipitating the arsenious acid with sulphuretted hydrogen; or by oxidising the arsenious acid and precipitating as the arsenate of ammonia and magnesia. As for the antimony, its presence may easily be detected by treating the black powder, which has been separated by filtration, with concentrated nitric acid, evaporating to dryness on a water-bath, and dissolving out the nitrate of silver with water. If antimony was present, it will remain as antimonic acid.

This process may be employed for separating very minute quantities of antimony and arsenic, but the results obtained when these bodies are present in considerable proportions, although they approach very nearly to the truth, are not quite exact, owing to the formation of a small quantity of a black powder, which is insoluble in hydrochloric acid, and was found to contain antimony, arsenic, and zinc.

A similar phenomenon was observed by Wiederhold,‡ when an alloy of five parts of zinc and one of antimony was dissolved in dilute sulphuric acid; a small quantity of a black powder remained undissolved which was insoluble in dilute acids, and on analysis was found to contain antimony, zinc, and lead.(?) [A process almost, if not quite, identical with the above is in common use in laboratories.—Ed. C. N.]

On the Non existence of Carotine.§

The red crystals found in the ligneous parenchyma of the carrot, and which have been considered as due to the immediate principles—carotine and hydrocarotine—are, according to MM. Frordo and Soeaur, nothing more than cholesterine coloured by a red pigment.‖

They possess its crystalline form, its solubility in various vehicles, its indifference with regard to reagents, and its centesimal composition.

There seems to be no relation between the proportion of these crystals and that of the fecula contained in the carrot. Moreover, some chemists maintain that the carrot we have experimented upon is the kind which contains the smallest quantity of fecula, that the wild carrot contains the most (two-thirds of its weight in the dry state), and that that used for feeding cattle much resembles the wild carrot in this respect.

The amylaceous principle decreases from the exterior to the interior; it is accumulated in the rind and medullary rays; the maximum is found in the cortical cellules near the cambium.

The granules vary in size. When, in consequence of the growth of the leaves and roots, these granules reabsorb, a dark core may be observed in them.

Hence it results that the season influences the amount of fecula, which accounts for the greater quantity in autumn than in summer, and also for its occasional entire absence. This variability has been already mentioned by Vauquelin, as well as by Bouchardat. Schmidt found afterwards from 7 to 8 per cent. of cane-sugar in the carrot.

MM. Frorde and Soeaur also ascertained the presence of asparagine, and, they believe, of bimalate of lime.

PHARMACY, TOXICOLOGY, &c.

Liebig's Extract of Meat.

The following communication from Baron Liebig appears in the *Pharmaceutical Journal* for November:—

In the last number of your journal (October, p. 196), I find an excellent contribution from Messrs. Deane and Brady on "The Results of the Micro-Chemical Examination of Extract of Flesh."

I beg you will allow me to make a few remarks which may form a proper basis of judgment of extract of meat, and particularly of South American, respecting its colour, taste, and consistency.

You are probably aware of my having accepted the office of Director of the Scientific Department of Liebig's Extract of Meat Company (Limited), and on conditions calculated to offer to the public a complete guarantee of

* *Ann. de Chim. et Phys.*, t. ix., p. 472.
† *Ann. du Conservatoire*, t. vi., p. 144.

‡ *Ann. Pogg.*, cxxii., 491.
§ *Arch. der Pharm.*, cxxvi., 204.
‖ This is not the first time cholesterine has been found in vegetables—see *Arch. der Pharm*, xlii., 527, analysis of a work by M. Beneke, where the existence in plants of this immediate principle is put beyond a doubt, though it has hitherto been considered as exclusively proper to the animal organism.

the genuineness and purity of the extract manufactured by that company.

One of my former assistants, Mr. Seckamp, is the manager of the chemical branch of the manufactory at Fray Bentos; another of my assistants, Dr. Ch. Finck, is acting at the general depot of the company. One manufactures the extract according to my special directions; the other receives it at Antwerp, and is bound to take a sample of each package, and to forward it to my laboratory at Munich for analysis. The packages are tin canisters of 36 to 45 lbs. each; the extract is sold only after being approved by myself. You will perceive thereby, that I not only control the manufacture according to my process of the extract at Fray Bentos, but also its quality when sold by "Liebig's Extract of Meat Company (Limited)," and I may safely assert, therefore, that the Fray Bentos extract does not contain any gelatine, or anything that can be considered as such.

Gelatine does not belong to the composition of extract of meat, and must, therefore, be excluded as much as possible; it gives more consistency to the extract, and allows, to the detriment of buyers, of a larger percentage of water, and makes it liable to turn mouldy. But the action of tannic acid, as a reagent, might lead to erroneous conclusions, against which it is necessary to guard.

In my little work "On the Chemistry of Food" (Taylor and Walton, London, 1847), I say, p. 141: "The portion of juice of the flesh which is soluble in cold water, but not in alcohol, is precipitated by tannic acid; the precipitate softens like plaster in hot water, and cannot be distinguished from the tannate of gelatine, but it differs from gelatine by that characteristic property of both, that it does not gelatinise when concentrated." Extract of meat, then, may and does precipitate with tannic acid, even when entirely free from gelatine.

By the exclusion of gelatine, the yield in extract is naturally diminished. According to a recent communication received from Mr. Seekamp, 34 lbs. of fresh lean meat yield only 1 lb. of extract, as manufactured at Fray Bentos (corresponding with 45 to 48 lbs. of butchers' meat, inclusive of fat and bones).

It has been observed that the colour and taste of the Fray Bentos extract vary; this is owing to the difference of sex and age of the animals.

The meat of oxen always yields an extract of darker colour and stronger flavour, reminding somewhat of the flavour of fresh venison, pleasant when diluted; the extract of cows' meat is of lighter colour, and a mild flavour, and is preferred by many persons. The meat of animals under four years cannot be used for the manufacture of extract; it yields a pappy extract of weak taste, like veal, and without flavour.

According to the predominance of ox or cows' meat, the colour and taste of extract varies, which is by no means a fault of the manufacturing process, and is fully explained by the preceding remarks. The extract of ox meat is, however, richer in creatinine and sarkin than the cows' meat extract.

The extract received from Munich, and examined by Messrs. Deane and Brady, was cows' meat extract—the Bavarian Pharmacopœia prescribing the use of cows' meat, and not of ox meat.

These gentlemen observed that they never experimented on a sample which they had any reason to believe to be adulterated with chloride of sodium (common salt). My experience has taught me that such falsification, more especially by retail dealers, is by no means a rare occurrence, and it is even practised by manufacturers.

I hold a sample of extract, manufactured by Dr. Tenner, of Darmstadt, containing 9 per cent. of common salt, and, besides, 26 per cent. of water more than the Fray Bentos extract. He sells it in jars, with labels stating that the extract is prepared "according to Liebig's process."

It is extremely difficult, as regards extracts of meat, the genuineness and purity of which are not discoverable by the eye, to protect the public against fraud; all manufacturers prepare their extract according to what they call "Liebig's process;" but since I have given only general, and not special, directions for manufacture, it so happens that every one fills in the details after his own fashion, and the consequence is that not one of these extracts is, in its composition, like another.

There exist only two special directions for the manufacture of extract of meat, the one in the Bavarian Pharmacopœia, the other in the Pharmacopœia Germanica, but these directions are not mine.

Munich, October 22.

PHYSICAL SCIENCE.

A Certain and Efficacious Method of Preparing Glycerine Soaps Liquid, by M. J. Plateau.

When I published my fifth series, I had made numerous attempts to find the best way of preparing glyceric liquid; and, indeed, with this liquid, as I then prepared it, a bubble of one decimetre diameter, placed on an iron ring, in the open air of the room, remained for three hours; this persistence would seem great compared with the two minutes' maximum duration of a bubble of the same diameter, formed in the same circumstances, with a simple solution of soap. Again, several successive preparations made in the same manner had given similar results, so that I looked upon these methods as certain. But in the new preparations used during the following summer, always with English glycerine and Marseilles soap, bought at the same shop, I did not obtain the same success. I then felt the necessity of resuming the study of glyceric liquid, in order to discover surer methods and a more general application. I have thus arrived at a simple theory of the liquid in question, which theory will be found explained in the memoir, and which made me devise some means of preparation, the almost complete certainty of which I think I can now guarantee, having made use of them a great number of times with glycerines of two productions and two different soaps. Moreover, the surface acquired a persistency much superior to that obtained by the most successful of the first experiments.

English glycerine (Price's), recommended in my fifth series, always appears to me the best.

A warm room must be selected, and the temperature must not become lower than 20° C. during the whole continuance of the preparation—at least in the daytime. Some Marseilles soap is taken which has been recently bought, and therefore preserving all its moisture; this is cut into very small fragments, and one part in weight of it dissolved at a moderate heat in forty parts of distilled water. When the solution has sunk to almost the same temperature as the room, it is filtered; then three volumes of this solution and two volumes of Price's glycerine are poured into a flask and shaken vigorously and for a sufficient length of time for them to be well mixed; after which it is left for seven days. On the eighth morning the flask is plunged into water, which has been cooled by stirring pieces of ice in it, so as to

lower its temperature to about 3°, and this same temperature is maintained for six hours, by suitable additions of ice. The liquid is afterwards filtered through a very porous paper, but the contents of the filter must be prevented from getting warm again, otherwise the precipitate determined by the cold might partly dissolve; therefore, before filling the filter, a small stoppered tube, full of pieces of ice, is placed in it. This tube ought to be inclined so as to rest laterally against the filter; finally, the bottom of the flask which carries the funnel, is surrounded by pieces of ice. Then, taking the liquid from the cold bath, the filter is immediately filled. The first portions of the liquid which pass are thick; these are poured back, and after this has been repeated two or three times the liquid collected becomes absolutely clear. I need not add that if the filtration lasts very long the ice in the little tube must be renewed from time to time; as to that which is placed round the bottom of the flask, it is designed to prevent the reheating of the portions which passed first, and dissolving the precipitate. If the liquid is in a large quantity, it must be distributed in several filters, placed on separate flasks and acting simultaneously. The filtration being ended, the liquid is left to itself for ten days, and then the preparation is complete.

In the best conditions the liquid thus prepared gives extraordinary persistence. A bubble of one decimetre diameter, rested, in the open air of the apartment, on a ring of iron wire of four centimetres in diameter, previously wetted with the same liquid and left quiet, can maintain itself for eighteen hours—that is to say, six times as long as the liquid obtained by the method mentioned in my fifth series. The component substances of the liquid, being industrial products, vary more or less from one sample to another, so that I have only occasionally obtained the above result. However, the superiority of my new method, and the degree of confidence which it deserves, may be judged of by what follows.

Of twenty-one preparations effected successively during the last four summers, and with different samples of Price's glycerine and Marseilles soap, two only, in which the glycerine and soap were the same, gave me bad results, but I have good reason to suspect that there was an error in the weight of the soap. All these liquids have been tried by means of a bubble of one decimetre, rested on a ring, as I have said. Omitting the two failures, there remain nineteen samples, for three of which the maximum persistence was five hours, for three others seven hours, for two eight hours, for four nine hours, for four ten hours, for one eleven hours, for one twelve hours, and for one eighteen hours.

It is very remarkable, that, when the persistence is great enough, the film, after an hour or two, attains an obviously uniform thickness over the whole bubble, except, indeed, the small lower cap intercepted by the metallic ring. This uniformity is discovered in the disposition of the colours.

Moreover (and this is not less worthy of interest), the colours first rise towards the first orders, then generally come down again to the red and green of the last, and sometimes even nearly to the white. This retrogradation of tints proceeds, as I have shown in my fifth series, from the glyceric liquid absorbing the humidity of the surrounding air.

The theory which I have made of glyceric liquid leads again to this conclusion—that, by substituting some pure oleate of soda for Marseilles soap, a liquid superior even to the best prepared from soap may, by a far simpler method, be obtained, and this is fully confirmed by experiment; indeed, I found it sufficient to dissolve at a moderate heat the oleate of soda in distilled water, then to mix the glycerine with this solution, the whole in rather different proportions to those of the soap liquids. By the next day or the day after, the liquids thus prepared were ready for experiments, and they continually gave me bubbles of one decimetre in the open air, the maximum persistence of which exceeded twenty-four hours. The solution of oleate of soda is then the true glyceric liquid; it is that of theory, it excels that of soap, and its preparation is of the easiest. Unfortunately, pure oleate of soda is not found in trade, and therefore, to procure it, it is necessary to have recourse to the scientific chemist.

In a close vessel the bubbles of glyceric liquid show a still greater persistence, especially when an absorbent substance, such as chloride of calcium, is deposited at the bottom of the vessel—for instance, with a liquid of oleate of soda, which was not particularly good, and gave in the free air a maximum persistence of only twelve hours, obtained, without desiccating the air of the vessel, a maximum persistence of forty-one hours, and, with desiccation, of more than fifty-four hours.—*Les Mondes.*

PROCEEDINGS OF SOCIETIES.

ROYAL SCHOOL OF MINES, MUSEUM OF PRACTICAL GEOLOGY.

A Course of Twelve Lectures on Chemical Geology, by Dr. Percy, F.R.S.

Lecture No. XII.

When speaking of the silicates of iron the other day, I ought to have dwelt a little longer on one or two points in connexion with them. I spoke of the so-called silicate of iron, said, on the authority of the late Dr. Thomson, to occur in the Mourne mountains in Ireland, but I have seen only one specimen of it. There is another silicate of iron, not a very satisfactory one, called cronstedtite. It is a silicate of the peroxide of iron. Silicate of iron, in combination, exists to a very large extent in minerals forming the crust of the earth—as, for example, in many volcanic rocks. It is there as silicate of peroxide of iron, and furnishes, of course, when those rocks are subjected to weathering or decomposing action, a fertile source of silica and iron, especially iron.

Of the compounds of copper, I think the first in order for our consideration is the well-known mineral called malschite—that beautiful green mineral so much prized by lapidaries and others for ornamental purposes. Here it is. It is a compound of carbonate of copper and oxide of copper. It may be easily made artificially by chemical decomposition. If to a solution of chloride of copper, for instance, we add a solution of carbonate of soda, this salt is thrown down as the resulting product, carbonic acid escaping. This carbonate has been obtained crystallised from protochloride of copper at a high temperature, or by double decomposition from protochloride of copper and bicarbonate of lime, kept at a temperature of 255° Centigrade during eighteen hours. These experiments are due to the late M. Senarmont.

The disulphide of copper is a very important compound in many respects, both mineralogically and chemically. We can very easily combine the two substances, sulphur and copper, simply by heating them, and we get occasionally, if fortune favour us with the production of accidental cavities in the mass, very variably formed crystals, but in the wet way it is clear that nature has formed this mineral. It may be prepared, according to Senarmont, by precipitating the salts of the deutoxide of copper—that is, red oxide—by alkaline sulphides, at a temperature

of 200° Centigrade, in presence of an excess of bicarbonate of soda or potash. There is a wet method, then, for its formation. Becquerel tells us that he has produced it by one of his electro-chemical methods—monosulphide of potassium acting for a long time upon a sheet of copper. This monosulphide—a common compound of sulphur and copper—acting on the sheet of copper produced crystallised disulphide. Then, again, it has been obtained crystallised by Durossé from the decomposition effected when the vapour of protochloride of copper comes in contact with sulphuretted hydrogen at a high temperature. The mineral is well known under the name of red ruthite. It is a very important ore of copper—one of the finest ores we have.

We will next take copper pyrites. This may be represented, as I said on a former occasion, as composed of one equivalent of bisulphide of copper (CuS_2), combined with one equivalent of the sesquisulphide of iron (Fe_2S_3). We can produce this compound by certain dry methods. Here is a specimen which we have produced directly by the action of heat. It is not exactly copper pyrites in point of composition, but nearly so. I gave you a proof on a former occasion, that copper pyrites in some cases must have been produced through the agency of liquids. On no other principle can we possibly account for its occurrence in the cracks of clay iron ore, to wit, where it is not unfrequently found. Senarmont has actually made it by a wet process, by exposing a mixture of perchloride of iron and chloride of copper, together with a solution of a higher sulphide of sodium than the monosulphide, in sufficient quantity to decompose the chlorides, and a great excess of bicarbonate of soda, to a temperature of 250° Cent. for some time. He thus got the mineral crystallised. The disulphide of copper is found occurring sometimes as a petrifying agent in the production of fossils.

Now as to lead. The ore of lead, *par excellence*, is, as I told you, galena, which is the sulphide of the metal. It occurs abundantly in nature, and with it, as I gave you reason to believe, is always associated an appreciable, though not pecuniarily valuable, proportion of gold and silver. The silver frequently occurs in very large quantity comparatively, and then becomes an object of profitable extraction. A very large quantity is produced in this country. All galena (I assert it again without fear of contradiction) from whatever source, whether European or American, will be found to yield sensible traces both of gold and silver. The association of these three minerals together is a very curious point worth dwelling upon.

Frémy made galena by the action of bisulphide of carbon upon litharge—not a method likely to have been employed by nature. He also made it by the action of the same compound upon other compounds of lead. Durossé made it by the action of sulphuretted hydrogen upon chloride of lead at a high temperature; and Becquerel made it by the action of sulphide of ammonium upon litharge—that is, protoxide of lead at a high temperature under pressure. Becquerel also obtained it by an electro-chemical method. He introduced some black sulphide of mercury into a glass tube, and poured thereon a solution of lead. After some six weeks, crystals of galena appeared just above the sulphide of mercury. I gave you proof of the aqueous formation of sulphide of lead; there is no doubt of its being so formed. I had a specimen from the Bedworth coal-field, in Warwickshire; it is a piece of coal in which there is a large massive lump of galena. I need hardly say that, the bituminous coal being unaltered, the lead must have been thrown down from an aqueous solution. Then, again, its occurrence in certain iron ores makes it pretty clear that in many cases, if not in all, the galena we meet with in nature has been produced in the wet way.

The action of air and moisture on galena may produce sulphate of lead. We find sometimes magnificent specimens of sulphate of lead or anglesite. I showed you some on a former occasion from America. We have had specimens from Anglesea, but they are now very rare. If sulphide of lead be decomposed by oxidation under certain conditions, the product must of necessity be sulphate of lead. The point of interest in connexion with this is that very frequently we do not find sulphate of lead upon galena which has been exposed to weathering action, but carbonate of lead. It is impossible to explain the formation of that by the action of air upon sulphide of lead. There must have been sulphate of lead first formed, and that being so, there must have been a subsequent decomposition by some agency, and there is one sufficient to account for it. I allude to bicarbonate of lime. I have given you the fact that by direct experiment there was immediate decomposition of freshly thrown down sulphate of lead by bicarbonate of lime in solution. Becquerel tells us that he got it crystallised by keeping galena in a concentrated solution of sulphate of copper and common salt for several years. I need not say anything about white lead or cerusite. It is a carbonate of lead produced from galena by the action of moist air. Cerusite is natural white lead. In the museum above there are perhaps some of the finest specimens in the world of this substance.

We now come to zinc. The oxide of zinc occurs in nature, and sometimes we obtain it as an artificial product in our furnaces. One of the most important natural compounds of zinc is undoubtedly blende—that is, the sulphide of zinc. This we can prepare directly, though not at all in a satisfactory manner, by heating zinc and sulphur together. It may, however, be produced by double decomposition from chloride of zinc and sulphuretted hydrogen brought together at a high temperature, or by passing a slow current of hydrogen over the amorphous sulphate of zinc. We obtain it amorphous easily enough at a bright red heat, and, according to Senarmont, it can be got crystallised by heating salts of zinc with alkaline sulphides at 175° Cent. Then, again, Becquerel has given us certain electro-chemical methods for making this sulphide of zinc. I need not trouble you with them.

Carbonate of zinc is a compound which, I think, there is no difficulty in accounting for the formation of. We can readily enough produce its solution in water containing carbonic acid; and when this is exposed to the action of the air, a portion of the carbonic acid goes off, and down goes the carbonate of zinc. I may direct your attention to a very fine illustration of this in the museum above, where you see a portion of stone from an old mine which had been long exposed to water containing carbonate of zinc in solution. It is encrusted with a beautiful layer of carbonate of zinc.

Now as to tin. The chief ore of tin, or *the* ore properly so called, is the ore consisting of tin and oxygen in the proportion in which they are combined in common peroxide of tin or stannic acid. There are one or two compounds of tin, which I will bring before you as interesting in a chemico-geological point of view.

We obtain the peroxide of tin crystallised sometimes as an accidental product in copper furnaces. Here is a very beautiful specimen of it, which was the result of sublimation in some way or other in a copper furnace. You will be able to inspect this afterwards. It is by no means commonly met with. It was supposed to be another oxide at first, but that has been proved to be an error. It is the true peroxide of tin crystallised by sublimation. It is well to bear these points in mind when we come to consider the bearing of volcanic methods of action upon geology. We have prepared it upon a small scale by sublimation. According to Deville it may be produced by the decomposition of chloride of tin by sodium, the two being brought together in a porcelain tube heated to bright redness.

With these remarks I will close what I have to say concerning the metals. I might amplify greatly upon this point, but it would take at least three or four lectures to do thorough justice to it. I have endeavoured to select such information concerning the metals as bears especially upon the formation of mineral lodes and veins. We shall shortly have to consider the subject of the formation of mineral lodes and veins, and there I shall generalise as much as I can; but before I take up that part of our subject I think it may be best to consider another very important one—namely, metamorphism. I need not say a great deal on that point.

What is meant by metamorphism? Of course it implies change of some kind. Is it simply a change in a sedimentary rock or some other rock effected subsequent to its deposition, and without any essential alteration in its percentage chemical constitution? No, I think not. I think the term "metamorphism" ought to be much more comprehensive and extensive than that. Here is the definition of metamorphic rocks which was given some time ago by Sir Charles Lyell. It is extracted from one of his books:—"A stratified division of hypogene rocks, highly crystalline, such as gneiss and mica schist, and so named because they have been altered by plutonic action." I would venture to suggest that this implies far too limited a definition of the term "metamorphism." That term, according to the notion of the present day, embraces various changes which do not come in that category. I have collected as far as I could all the various kinds of changes which may take place in rocks after their deposition, and I have endeavoured to classify them. Metamorphism is undoubtedly a subject of the first importance in geological philosophy.

Now, the first kind of metamorphism is that which is due to heat alone. Suppose the deposition of a sandstone rock, owing to fine grains of sand slowly subsiding during a long period of time, and then consolidating into a bed of sandstone. Now, what change will such a bed undergo by exposure to heat alone? Well, we have on the table one or two apt illustrations taken from furnaces, which I think you will say are somewhat striking in their character. If you take a piece of common sandstone and expose it for a long time to a high temperature—say to a bright red heat or even higher than that, as at the bottom of a blast furnace—you will find it very much changed in character. By a long time I mean some years. It will become harder and more firmly consolidated, and frequently split up into basaltic-like columns. Here is a specimen which has been so altered, simply, as far as we know, by the direct action of heat. Here is another specimen, which is, perhaps, still more striking, taken from the bed at the bottom of a blast furnace, where it was exposed to long-continued heat for some years. Here is a portion of common sandstone which has been employed for the bed of this furnace. Molten iron has lain on this year after year. That implies, you know, a pretty high temperature. Any geologist comparing this with the same rock before it has been exposed to the action of heat would be inclined to conclude that it was impossible that the one could be derived from the other by the simple action of heat alone. At all events, he might be sceptical about it. This is a very beautiful illustration. The sandstone has become converted into a hard, compact mass, quite different in appearance from the unchanged rock. You must be so good as to examine these two specimens side by side, and then you will be able to judge for yourselves of the alteration effected by the operation of heat alone. But bear in mind that in this particular case it is just possible—I admit that—that the change may, to a certain extent, have been brought about by means of a kaline vapour. We know that there is such vapour always in our blast furnaces, especially in the tower part, and it is possible to conceive that that has permeated the walls of the furnace and got down into the bed, and so transformed, or tended to transform, that sandstone into the metamorphic rock, if I may use the expression; but I do not think it probable that that has been formed in that way. There are certain difficulties in the vapour penetrating to the bottom of the furnace through the molten iron, but still it is a possibility. Here is another specimen. It is a piece of mica schist from Norway—probably, unmistakably, mica schist. There is the same rock which has been exposed to the action of heat in a furnace, and you see in many respects it has undergone a striking change. Here is another worthy of your attention. It is from the same rock in Norway, and is similarly changed. Nothing can have undergone a more decided transformation than this rock, and apparently by the action of heat alone. Here are other specimens telling the same story. This is a simple change by heat, whereby the particles are made to cohere more firmly together.

But there may be metamorphic action by heat in which there is a chemical rearrangement of the particles. That is a matter of great importance to bear in mind. We may take a rock having a certain chemical composition, and we may trace this rock out over a large area, and see it undergo a clear, unmistakable change in character, being transformed into another kind of rock apparently quite different in composition from the original, but still possessing the same percentage composition. This would show that heat has effected a transformation in the properties of the rock, its constituent proportions remaining the same. There is a very interesting paper bearing on this point lately published in the *Comptes Rendus*, which deserves attention. This rearrangement of particles is a very curious thing. Something of the same kind takes place in the devitrification of glass. There you may have a rearrangement of the particles simply by the operation of heat alone. Take a piece of common window glass, and expose it to a red heat: the glass shall become opaque, as you have seen, and highly crystallised, and the crystals so produced shall not be different from the "nother liquor," if I may so speak, or the matter in which they are embedded, as regards their ultimate chemical composition. That has been proved by analysis. Here is a change effected without fusion. Understand that distinctly. There are numbers of changes of this kind which take place entirely without fusion. That is a matter of great interest for geologists. There is no necessity for the theory of fusion in this matter. The rock may remain solid, and yet the action of the heat shall just remove the particles, so to speak, from one another, and allow them to rearrange themselves in different chemical groups.

I may give you an illustration of this in the common metal zinc. Various other metals give the same illustration. If I take a piece of common sheet zinc, of which chimney-pots are made, I can bend it backwards and forwards without breaking it, and on putting it to my ear I do not hear any cracking sound when it is bent; but if I gently heat it sensibly below its fusing point, I can then break it immediately, and on bending it I hear a distinct crackling sound just like that which is produced when tin is bent. Well, what has taken place? Simply by heating the metal below the fusing point, the particles are set free, to a certain extent, to vibrate, and they rearrange themselves in a crystalline form. The metal becomes highly crystalline in structure. I might give you illustrations of similar changes taking place without the application of heat. There are numbers of instances of that sort; but I should be going too far out of my subject to mention them. These facts derived from the metals give a very simple evidence of the changes which may occur by the operation of heat alone at very gentle temperatures—temperatures less than the fusing point of the substances. The transformation of clay slate into the stratified rock called gneiss is an illustration of this. The transition in some cases is most gradual. There is one result which we owe our knowledge of to Carius. He

analysed six different specimens from Löhen, in Saxony, illustrating the gradual passage of clay slate into gneiss, clay slate being distinct at one end and gneiss at the other. He did not succeed in detecting any appreciable difference in ultimate chemical composition in any part, and yet there was the most marked alteration in the physical characters of the rock, and also evidently in the chemical constitution. Approximately, each bit of the rock contained exactly the same proportion of elementa per cent. No doubt in one part of the rock there was a rearrangement of these particles so as to constitute specific mineral compounds which did not exist in the other. I may here call your attention to a fine geological rock which plays a very important part in this country. It is slate which has been exposed to the action of intense heat. You see it has become exactly like a porous mass of pumice.

This metamorphism due to a rearrangement of particles, without loss or without addition of matter, is a very wide subject, and one which deserves to have constant attention, and to be taken up more than it has hitherto been. There is no doubt that heat is one of the most fertile or one of the chief causes of effecting such a rearrangement.

The next kind of metamorphism is that which takes place with a loss of matter. Now I might give you many examples of this. There is the well-known mineral occurring abundantly in nature called porcelainite, or porcelain jasper. It is nothing more than a kind of clay which has been exposed to a pretty good heat for a long time. We can imitate this action. It has been burned into a sort of brick. The natural mineral is very pretty, but we can rival it by the artificial one. On examining a pit-mound, you will most likely discover beautiful specimens of shale which has been exposed to a long-continued heat, and as the result of that exposure you will see the shale beautifully marked with alternate bands of green and red. If we apply the term metamorphism to this action, this would be a change by the loss of matter. The clay has become simply dehydrated by the action of heat, and we get this pretty thing called porcelain jasper.

There may be a metamorphism by intermixture with contiguous matter. This is a point requiring very close examination. To illustrate this sort of change, I may refer to a case cited by Bunsen, where what he calls a pyroxenic rock, that is a volcanic rock containing about 50 per cent of silica, is traversed by a dyke of trachyte—that is, a rock containing a much larger quantity of silica—say about 80 per cent.—and represented by obsidian, of which you have a specimen before you. He took specimens and analysed them from the interior of the dyke, from the cheek of the dyke, and also from a part of the surrounding rock. Here he found there was a gradual transition from one into the other, showing this change in the walls of this fissure or dyke by the intermixture of contiguous matter. That is a kind of metamorphism which I think deserves attention. I need not trouble you with the exact numerical details of the analysis. I shall confine myself now to the general result. These details may be found in the admirable paper written by Bunsen—one of the best ever written on the subject—published in the "Cabinet of Sciences," first volume.

Then there is a metamorphism due to the action of water at a high temperature -- that is, hydrothermic action. I have already given you many examples of this action. Here is a remarkable class of examples from Daubrée's researches on the action of water at a high temperature upon various silicates, especially kaolin and obsidian, and particularly with waters containing a certain amount of alkali in solution. You will remember the action of water at 400° C. on glass. That was well deserving of attention. You remember how the glass was decomposed and so forth, and what the products were. We can decompose this obsidian or trachyte rock readily enough by the action of hot water or by superheated steam alone under great pressure; and there is no doubt that the natural volcanic rock has been so acted upon and decomposed in many instances. It thus loses completely its glassy character, and becomes changed into a crystalline fine-grained trachyte. The powder so formed presents under the microscope all the characters of felspar. Obsidian differs from felspar in containing a little more silica, and this is easily removed along with the alkaline silicate dissolved out of the glass, the residue consisting of felspar. Then, again, I may recall your attention to the fact that china clay, common silicate of alumina, when treated in a similar manner, produces felspar. It was changed into a confusedly crystalline substance, and the crystals were small prisms which cut glass. They were not acted upon by hydrochloric acid. Daubrée asserts that it was a double silicate of alumina and alkali, having all the properties of felspar, and was mixed with a little crystallised quartz. Now, that is a curious point. I told you we could transform felspar into kaolin. We know that is a fact, because we see it done every day in Cornwall and elsewhere when granite is undergoing decomposition. Here, on the other hand, we can reconstruct the felspar by acting upon that kaolin with silicate of alumina and hot water. Now, that is a very beautiful consideration. We cannot only obtain clay from the destruction of felspar, but we can recompose our felspar from the clay so obtained by the action of hot alkaline water. Simple as these experiments of Daubrée and others are, it appears to me that they have marvellous significance with respect to the great phenomena of chemical geology, and they cannot be too closely studied. Here, again, Daubrée has made some very important observations upon this hydrothermic action at Rothan, in the Vosges. I think I can hardly do better than give you his words:—"Syenitic granite has penetrated Devonian beds which, even to the distance of several hundreds of metres from the point of contact, are entirely modified. In certain points the rock is wholly formed of a mixture of lamellar augite, epidote, and compact garnet, with some galena." In the middle of the rock formed of these silicates, Daubrée found numerous polypes perfectly well preserved. Even the cavities left by the partial disappearance of the calcareous substances of these polypes were studded over with crystals of the same mineral as formed the matrix. The most abundant was black hornblende, in elongated perfectly defined crystals, penetrating nearly into the crystals of quartz, as is frequently seen in the middle of rocks having lost all traces of fossils. Grass-green garnet also occurs, completely recalling that of Morzoni in the Tyrol and of Drammen in Norway. Large crystals of axinite were also discovered by Daubrée, of which the presence had not been previously recognised under similar conditions in fossiliferous rocks. It is clear that these changes—and very marvellous changes they are—are all effected by the percolating action of water upon these rocks. Daubrée concludes (these are his own words):—"The organic remains so well preserved at Rothan deserve to be regarded as classical monuments of metamorphosis. They teach us, in fact, that a rock, incontestably of sedimentary origin, is now formed of anhydrous and crystallised silicates, such as augite, hornblende, garnet, epidote, and axinite; and further, that this rock has been profoundly transformed without notably softening, since the *délicatesses* [that is his own word] of the surface of the polypes are well preserved in it." Well, that is an important point, and it appears well worthy of your careful reflection. "Metamorphism of this kind," he goes on to say, "explains how the angular edges of numerous fragments which are very often met with in granites from the most different localities should have been preserved." Daubrée insists upon the connexion between the metamorphism of stratified beds and dislocation, and the connexion of dislocation with the occurrence of thermal waters. All that you require is immense pressure at great depths and corre-

sponding degrees of temperature. He has calculated that over three-quarters of the globe thermal waters cannot rise except by overcoming the pressure of the water of the ocean, which on the average may be taken at 200 atmospheres.

Another kind of metamorphism is that which takes place by the removal of part of the constituents of a rock by the mechanical action of water—not by its chemical action. Take, for example, the washing out of argillaceous, or ferruginous, or other mechanically mixed matter from a sandstone rock. That such transformations have taken place we have abundant proof; and the rock so deprived of its ingredients by the mechanical operation of washing is transformed into quartzite—that is, a metamorphosed sandstone.

Itacolumite, on which I dwelt so long when speaking of the diamond, is a kind of quartzite. This is a metamorphism entirely due to the washing action of water, some of the constituents of the original rock being washed out, and other matters being left in their place, without disturbing the form of the rock.

There is a metamorphism due to the solvent action of liquids. I have already considered this metamorphism as regards the possible formation of dolomite. I need not recur to that again. This solvent action may take place in nature on a very large scale, upon our so-called igneous rocks containing silicates, which are slowly decomposed by water, especially when that water contains carbonic acid in solution. It then becomes slowly decomposed and disintegrated, and the matter so dissolved out is thrown down in different states of combination. We spoke especially in a former lecture of the decomposition of silicate of lime by this means.

Metamorphism may take place by the deposition of matter from solution. Silicification may be taken as an example of this kind of metamorphism. At Kolman, in Alsace, mischelkalk in contact with granite is changed into hornstone from the action of springs containing silica. There is the positive fact. The same thing is observed in Kentucky on a large scale. This is a point which we have investigated with reference to the theories of the formation of dolomite. It is a matter which requires much further work on the part of chemists and geologists combined.

There is metamorphism by the addition of water, and of this I can give a most capital example in the gradual conversion of anhydride—that is, an anhydrous sulphate of lime—into the hydrated gypsum or common gypsum. This may be seen at St. Gothard in every stage of conversion.

Then there is a metamorphism by oxidation and hydration. I think we are justified in applying the term metamorphism to this change. Take the two actions together, and as an example we have the conversion of beds of carbonate of iron into peroxide. Surely that is worthy of the name of metamorphism. It is a change which may occur on these beds of carbonate of iron to a very great depth, and on that account I maintain that the term metamorphism may be properly applied to a change of this kind. No doubt that this Northampton iron ore has been derived from the carbonate entirely through the weathering action of air and the addition of water in combination. Understand what takes place. The carbonate of iron loses its carbonic acid, which escapes wholly; and the protoxide of iron takes up oxygen from the air and becomes converted into peroxide, and that peroxide enters into combination with water and becomes hydrated, and thus you get these brown iron ores formed.

Now we come to metamorphism as the result of volcanic exhalations. This is a subject especially worthy of study, Bunsen especially has examined it with great care, and directed the attention of geologists to it. All these points are matters of great interest for the chemist and geologist in unison, and they constitute an important part of the glorious science of the history of our globe or of its formation. Now, the agents which seem to have played an important part in this action are steam, hydrochloric acid, sulphuretted hydrogen, and carbonic acid. This action is very properly termed by Bunsen "pneumatolytic" action. As an illustration of the action, take the case of obsidian, which may be decomposed by the action of hydrochloric acid vapour. Bunsen has given us a clear demonstration of this change. There is no difficulty whatever in accounting for the formation of clay by this kind of action—namely, by the disintegration and decomposition of obsidian by the vapour of hydrochloric acid. It is not a question of doubt; it is a question of fact, established by observation. No doubt there are other sources of clay, but this is one, and a source which may have existed to a very large extent for aught we know. There is a volcano in Java the whole crater of which is filled with boiling mud, from which hydrochloric acid is evolved. We are told in connexion with this volcano that it is dangerous even to approach it, in consequence of the changes produced by the action of the acid. In Ireland, too, gypsum is produced by the action of sulphurous acid on a particular rock called palagonite. Then we have, too, sulphuretted hydrogen and carbonic acid resulting from volcanic action. These may have played an important part in bringing about many changes. The hydrogen may have become oxidised and the sulphur thrown down in combination with a metal; and in this way we could account for the formation of many sulphides if we only admit the presence of sulphuretted hydrogen.

The last kind of metamorphism is one which has been mentioned of late by Bischoff, and is worthy of the especial attention of geologists. There seems to be good reason for supposing—though I cannot go into the proofs now—that carbonic acid existed in former ages to a much greater extent than now, and this is supposed to have played a very important part in the weathering action of rocks, silicates having been decomposed, and carbonates being the result of such decomposition. But the question to which I refer now is the relative volumes of the rock thus acted upon, and the products of the rock in which we find the carbonic acid contained. That is the point. We will take, for example, basalt; that is one which Bunsen gives. It has, we will say, a volume of 33·33—the third of a hundred. Very well, on weathering by the influence of carbonic acid and water, that basalt becomes converted into quartz and kaolin and carbonate of lime, and carbonate of magnesia, and carbonate of potash, and so on, and the volume increases to 70·93. Thus, admitting this action, the volume of the rocks, you see, has been largely augmented by the abstraction of the carbonic acid from the air. Now, that is a matter of necessity. Hence this kind of action may have taken a prominent part in determining the conformation of land. Imagine a great rock, consisting of silicates, thus decomposed and converted into these substances – quartz, kaolin, and so on—by the action of carbonic acid, and then see what an enormous increase of volume must have taken place. This is a very important subject, and one well worthy of investigation.

I think I have laid before you all the main facts, generalised as far as possible, that pertain to metamorphism. Of course, to properly discuss the matter in its geological bearings would require several lectures. I am now speaking of the essential chemical nature of those changes which, as far as we know, may be classed properly under the head of metamorphism.

The next subject on which we shall treat is fossilisation. This will not occupy so long. By fossilisation I mean the change of the remains of animals and plants into stone-like matter, commonly called "petrification." We must be careful to distinguish here between this and the common petrification, which is nothing more than an incrustation, such as we see on birds' nests and other things at Matlock Bath, in Derbyshire, where the water contains carbonate

of lime held in solution by carbonic acid. When articles are exposed to the action of this water, carbonic acid escapes, and they are incrusted most beautifully with a deposit of carbonate of lime. That, however, is simply incrustation, and not fossilisation, and is similar to the incrustation of copper, which is deposited in the electrotype process. We have very fine specimens of this deposition of carbonate of lime at Carlsbad, which I have no doubt many persons here present know. Silica we frequently find incrusting as well as carbonate of lime. At St. Michael's, in the Azores, for example, it is stated that there is a stream containing so much silica that plants in it are said to have their tissues replaced entirely by silica. The organic part is gradually removed, and, *pari passu*, the silica is deposited. Then we find other substances, capable of being separated from solution by exposure to the air, acting as incrusting agents.

In the process of fossilisation, we have first of all the filling up of the casts or fossils of organic bodies by various means. The original substance has been removed, and left a mould, and the mould is filled up by some deposit. This is one kind of fossilisation. It is sometimes filled up with the same kind of matter as the stuff in which it occurred—sometimes with another. Thus we may have casts in sandstone filled up with sand, and sometimes with different kinds of matter. In the common echinus in the chalk, the interior is filled with flint, while the shell is changed into calcspar; yet all this has occurred in the chalk itself.

We have fossilisation by carbonate of lime. In the shells of living animals the carbonate of lime is either amorphous or in the state of arragonite. Now, in the crinoids the stems break with a very curious rhombic fracture, and each joint seems to form a distinct crystal, and the internal alimentary canal is always the main axis of the crystal. If we break a series of these joints in succession, we find that the crystals are all turned at a certain angle, but we do not find that the cleavage planes are parallel. That is a very curious point.

Next, there is fossilisation by means of silica, of which we have some very fine specimens. For example, here is one—fossil wood. That is a very interesting kind of fossilisation. No doubt that wood has been exposed for a very long period of time to the action of water containing silica in solution, and in proportion as the vegetable matter has been removed, particles of silica have been deposited, and so we gradually get a compact mass in which the whole structure of the wood has been preserved. It is one of the most beautiful kinds of fossilisation we meet with.

Sometimes we find that iron pyrites replaces organic remains. Some of the most beautiful specimens which we obtain, and which are really ornamental to a geological cabinet, are some of these exquisite little ammonites. They are most beautiful things when cut. It is stated that in bivalve shells—and this is an interesting point — we do not meet with this replacement, and the reason for it seems to be satisfactory. The iron pyrites seems to be generated by the action of decomposing organic matter upon sulphates in solution in water. I think there is no doubt about that in the majority of cases. Of course there must also be iron present at the time. Well, in the case of bivalve shells this decomposing matter readily escapes and flows away, or is otherwise removed, and therefore we do not find replacement by pyrites as we do in those shells where the matter is retained. That is the explanation that is given, but whether it is altogether satisfactory to you it is not for me to say. I ought, perhaps, to have spoken with a little more reserve. I think a little more investigation is required before the explanation can be established as a fact.

Then we have replacement by means of hydrated sesquioxide of iron, pseudomorphous after pyrites. I mentioned that on a former occasion. I might go on amplifying very much on this part of our subject.

For fossilisation all we want is the replacement of the organic matter, which is removed, *pari passu*, by some other matter, and that may be done with almost any substance. For instance, fossilisation may occur from red iron ore, from sparry iron ore, and even from specular iron ore. Gypsum is also an agent in fossilisation This is shown in the stratum of fossiliferous gypsum in the Keuper formation in Wirtemberg. There are also gypsum casts of shells at Montmartre, near Paris.

Then we find vivianite, or blue phosphate of iron, in fossil shells in the Black Sea.

Fluor spar is sometimes an agent of fossilisation. There is no difficulty whatever in accounting for this, because we find fluor spar almost everywhere. It exists in sea water, and in certain mineral springs in small quantity. I might have given you positive proof of this if I had gone into that subject. The quantity, as I have said, is small; but still, when we come to consider the operation of water like that through ages—not only thousands of years, but tens of thousands of years—we can readily understand how this small quantity may in time produce vast results.

Fossils in sulphate of baryta are sometimes found. I have seen several such in the lias of France, and in ammonites at Whitby. This sulphate has gone down from water. We know that it exists in water, and in sea water, and in our clay iron ores. I might have shown you specimens of these clay iron ores containing sulphate of baryta in their fissures.

Then, again, sulphate of strontia is another substance of which fossils are formed. Here are specimens in which replacement by that compound has occurred.

Sulphate of lead has also been found in fossils in France. Carbonate of lead has also formed fossils.

Again, fossils have been found to consist of blende, or sulphate of zinc. This is another proof of its aqueous formation.

Carbonate of copper and green silicate of copper may be mentioned as agents in fossilisation, besides many other mineral substances which I need not enumerate.

Before touching the last subject of our lecture, I must just say what I intended to say upon mineral veins and lodes; and I shall do this as briefly as I can. Of course the subject of these lodes, to be treated properly, would require a very long time—a course of a dozen lectures, or even more than that; but to treat it at great length is quite out of the question on the present occasion, and I shall hence try to generalise as much as possible.

Now, a metalliferous lode is nothing more, really, than a great crack in the earth, formed in some way or other, and filled in gradually by metalliferous matter. That is certain. Let us, then, consider the principle which applies to the mode of filling up. I shall do no more than that on the present occasion.

Before you are several specimens illustrating the mode of filling up, and very fine specimens they are. In the museum above are other specimens illustrating the same point. You could not have a finer series than is there found.

Now let us suppose a great crack in the earth. This crack becomes filled in in course of time, and if the matter filling it be metalliferous, it will constitute a metalliferous lode—a lode properly so called, or a vein. These metalliferous matters occur here as strings. Here is some galena intermixed with other kinds of matter which are called "vein stuff," or the matrix, or it may be that it is intermixed with the cheek or wall of the vein, which is more properly called "vein stuff."

Now, let us see how this filling up may occur. Various theories may be put forth; but there is no doubt, considering all the facts which we have now passed in review with regard to the formation of sulphides and so forth, and other facts, that all these metalliferous veins have been produced by aqueous action, and not by igneous action, as one might have supposed. Look at the metals occurring

in them—galena, carbonate of iron, and other things which never could have been produced at a high temperature, in that condition at all events—and then say whether it is possible to arrive at any other conclusion.

Now, we may have a fissure in a rock, for example, filled up from the side uniformly by lateral accretion or growth of the side. There shall be a substance added nearly equally to each side, the fissure being supposed to be filled with water. You may assume that there may be a free percolation of water, containing sulphate of baryta, from above or below. Thus you may get a deposit of sulphate of baryta. That is very sparingly soluble in water, it is true, but still it is soluble; and by the action of such water year after year and age after age, we get a distinct deposit of sulphate of baryta. Then, perhaps, the nature of the water may change, and we may get galena deposited on the side, the proportion varying in different parts of the vein, and so on. Then, again, possibly you may get fluor spar, or something of the same sort. Then you may get a quantity of iron pyrites deposited in the same way, till at length we have the whole vein filled up with various kinds of matter, sometimes beautifully distributed in symmetrical bands, and existing on each side of the medial or central line which you will find in some of these specimens. There is no difficulty at all in accounting for the formation of these veins in that way. We know that water is at hand, and is easily accessible to these veins, and must, and does, convey the matter of which these veins are composed. We have seen from the observations of Daubrée how water percolating through a fissure in a rock may by its action change the rock for many metres. You will see this illustrated here in this specimen. These cracks have been filled in with copper pyrites, and you see how the matter contiguous to the copper pyrites has been gradually changed.

Secondly, there is the theory of the formation of lodes by infiltration. It is possible—nay, it is more than possible, it is certain in some cases—that hot springs arising from below have contributed to the formation of veins. There is no doubt whatever on the matter. The metalliferous matter (and this is a point which has often struck me as interesting) may have gone down from water from above, or may have come up from below. We do not find in many cases this metalliferous matter extending equally through a great depth of the vein. Sometimes it stops at one place, and sometimes at another. We know perfectly well that water does contain these matters. Take the fact that I mentioned to you with regard to copper in anthracite coal, and silver in clay iron ores. These must have gone down from water, showing the certainty of the occurrence of metals of this kind in solution at some former time, and extending over a large area. All we want is some solvent of these bodies, and that water should get access to the veins, and then we can easily understand how a deposition may have taken place, first of one substance and then of another. It is perfectly possible that electro-chemical action may have taken place as some suppose; but we know so little about that, that it is vain to speculate further about it.

Then, again, it has been suggested that sublimation may have played some part in the production of mineral lodes. This is a favourite theory of some persons, but it is one, I think, which will not bear much investigation. I am not prepared to say that sublimation may not have been the cause in some cases, but I state most unhesitatingly that in many cases, at all events—in the majority of cases—that theory will not explain what we observe in the veins themselves; and if the theory be of any account it is not one of much importance, seeing that this action must have been very limited as far as we can make out. I could give you many facts in support of what I am saying.

We have also the theory of the injection of molten matter. Well, that will not apply in many cases to metalliferous veins. It is perfectly certain that this could not produce a vein like that containing galena, baryta, and so on—simply the pouring in of molten matter. There are known metalliferous veins which have been produced undoubtedly by injection. Take, for instance, the veins of trachyte or basalt going through rocks, or take the veins which, I am sorry to say, we not unfrequently find in Staffordshire, where we meet with an igneous rock running through the coal. But cases of this kind are comparatively limited.

(To be continued.)

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, November 27, 1866.

E. W. Binney, *F.R.S., F.G.S., Vice-President, in the Chair.*

Among the donations announced was a beautiful series of preparations of the spores of fungi on glass, from Sir J. F. W. Herschel, Bart., M. A., F.R.S., &c. &c.

On the motion of Mr. Spence, seconded by Dr. Joule, the thanks of the Society were unanimously voted to Sir John Herschel for his valuable donation.

"*Observations of the Meteoric Shower of November 13-14, 1866,*" by Joseph Baxendell, F.R.A.S.

The early part of the night of November 13 was very squally and cloudy, with showers of rain and hail and occasional flashes of lightning. At about 12h. 15m. a break occurred near the zenith, and in a few minutes the clouds had almost entirely disappeared. My observations of the meteors commenced at 12h. 16m. Greenwich mean time, and were directed principally to the determination of the time of maximum frequency, and the position of the radiant point. The observations of frequency were as follows:—

				Number of Meteors Observed.
From 12h.	16m.	to 12h.	32m.	60
	32		48	153
	48	13	4	287
13	4		20	378
	20		26	122
	26		42	316
14	19	14	42	54
15	20	15	35	6

From 13h. 42m. to 14h. 19m., and again from 14h. 42m. to 15h. 20m., the observations were interrupted by clouds and rain, and only 73 meteors were counted during the two intervals. At 15h. 35m. clouds came on again very suddenly, and the sky remained obscured at 16h. 5m., when I ceased to watch.

During the whole time of observation the sky was rarely entirely free from clouds for more than two or three minutes, but the errors arising from this cause are probably pretty evenly distributed through the intervals above given, and cannot therefore materially affect the final determination of the time of maximum frequency. The results of the observations are as follows:—

		Average Number of Meteors per Minute.
At 12h.	24m.	3·7
	40	9·5
	56	17·9
13	12	23·6
	23	20·3
	34	19·7
14	30½	2·3
15	27½	0·4

The curve formed by a projection of these numbers gives 13h. 12m. as the time of maximum frequency. The probable error of this result can hardly exceed one minute.

In order to determine the position of the radiant point, the positions of the intersecting points of the paths, continued backwards, of a great number of pairs of meteors

were noted. By far the greater number of these points fell on a space bounded by lines joining the stars γ, ζ, μ, ϵ, and η Leonis, and, allowing equal weights to all the observations, the mean position was found to be R. A. 9h. 58m. 12s. = 149° 33′; Dec. 22° 57·5′ North. Calculating the position referred to the ecliptic, we have Long. = 143° 41·0′; Lat. = 9° 54·5′ North.

At the time of maximum frequency the earth was advancing in the direction of a point on the ecliptic, the longitude of which was 141° 28·3′, or 2° 12·7′ less than that of the radiant. It appears, therefore, that the meteors were crossing the earth's orbit from within outwards, and that their aphelion distance is very sensibly greater than the earth's radius vector on November 13.

The velocity of the earth in its orbit on November 13 is 18·38 miles per second, and the velocity of the November meteors when they enter the earth's atmosphere has been found to be forty miles per second. With these data and the latitude of the radiant point as given above, 9° 54·5′ N., we find that the inclination of the orbit of the mass of meteors to the plane of the ecliptic is 17° 59′, and that their orbital velocity at the time they encounter the earth is 22·31 miles per second. The excess of this velocity over that due to their distance from the sun arises, in part at least, from the accelerating effect of the earth's attraction.

An attempt was made to estimate roughly the relative numbers of meteors of different magnitudes, and it was found that they occurred in about the following proportions:—

Out of every 100 meteors,

10	were above the	1st	mag.; the brightest of these were 2 to 3 times brighter than Sirius;	
15	were between the	1st	and	2nd mag.
25	„ „	„	2nd and	3rd mag.
30	„ „	„	3rd and	4th mag.
15	„ „	„	4th and	5th mag.
5	„ below	„	5th mag.	

The average magnitude was 3·0.

The trains left by many of the larger meteors had a beautiful emerald-green colour, others were of an ashy grey, and the remainder white. The meteors themselves were mostly white or bluish white, but many were of a fine golden colour.

In order to give some idea of the great velocity with which the meteors enter the earth's atmosphere, it may be remarked that it would be sufficient to carry a body through the entire circuit of the earth in an interval of less than ten and a half minutes.

As I had the good fortune to witness the great meteoric shower which occurred on the morning of Nov. 13, 1833, I may state that the late display was far inferior to it both in the number of meteors seen and in the brilliancy of the larger ones, and I am therefore inclined to think that a much finer display may be expected to occur in November next. At the time of the 1833 great shower I was at sea off the west coast of central America, and although I then knew little about meteors, and the idea of a radiant point had not, so far as I am aware, ever occurred to any astronomer or meteorologist, the tendency of the great majority of the meteors to diverge from a particular region of the heavens was so strongly marked that it at once engaged my attention, and I find on referring to my notes that I fixed the central point of this region in the constellation Cancer, a few degrees east of the stars δ and γ, and not in Leo, as observed by Professor Olmstead and others, in the north-western portion of the North American continent. A great number of the meteors, however, had other radiant points, and some of the finest moved in long horizontal arcs, or in directions nearly perpendicular to that of the main stream. This fact seems to me to be strongly opposed to the cosmical theory of meteorites, except on the rather improbable supposition that the earth, on that occasion, encountered two or more groups, all, at the same time, crossing each other's orbits, as well as the orbit of the earth. It may, however, be urged that such a supposition is hardly more unlikely than that which ascribes the November meteors to a ring of small bodies moving round the sun in an orbit differing little in magnitude from the earth's orbit, but the motion being retrograde, or contrary to that of the earth, and therefore inconsistent with the general analogies of the solar system, and opposed to Laplace's almost universally received nebular hypothesis.

ACADEMY OF SCIENCES.

December 3.

"*On Endosmose and Dialysis*," by T. Graham. In this paper Professor Graham comments upon a paper by M. Dubrunfaut, which was read at a recent meeting of the Academy. In April, 1854, M. Dubrunfaut patented a method of removing salts from beetroot sugar by an osmometric process, and claimed this as an anticipation of Professor Graham's work on Osmose, published in June, 1864. Professor Graham now reminds him that what M. Dubrunfaut patented in 1854 had been fully described in principle in the Professor's principal memoir on the Diffusion of Liquids, published in 1849.

"*Comparative Experiments on the Vital Resistance of certain Vegetable Embryos*," by M. F. A. Pouchet. The author finds that the seeds of the *Medicago* (American) will germinate after having been boiled in water for four hours. Other seeds would not, however, bear 15 minutes' boiling.

"*On the Action of Aqua Regia on Silver: New Battery*," by M. Roullion. A mixture consisting of two-thirds hydrochloric and one-third nitric, or three-fifths hydrochloric and two-fifths nitric acids, will easily dissolve gold and platinum, but will only superficially attack pure unalloyed silver; a superficial chloride being formed, which protects the rest of the silver like an impermeable varnish, however long it may remain in the aqua regia. If copper be present, the metal is attacked. M. Roullion has utilised this fact to make a new battery in which pure silver in aqua regia replaces the platinum or carbon in the nitric acid of a Grove's or Bunsen's cell. He says that after several months' use the silver has not sensibly diminished in volume, and no chloride of silver has been found in the porous cell. He considers this battery more constant than Bunsen's battery.

"*Sixth Memoir on the Mechanical Theory of Heat*," by M. A. Dupré.

"*On the Shooting Stars on the Night of November* 13-14," by M. Phipson.

The same subject by M. E. Guillemin.

The same subject by MM. J. Silbermann and A. Guillemin.

"*Facts relating to Coal-tar Colours*," by MM. G. de Laire, C. Girard, and P. Chapoteaut. This paper is an important one, and will be published in full in an early number.

"*On the Alloying Tungsten with Iron by the Wilkinson Furnace*," by M. P. Leguen.

"*On Hypoiodous Acid and its direct Combinations with Hydrocarbons*," by M. E. Lippmann. When iodine, oxide of mercury, and amylene are mixed in the presence of water, iodide of mercury is formed, and hypoiodous acid, which combines with the amylene to form iodhydrine, heavier than water. When this iodhydrine is treated with acetate of silver, there are formed acetic acid, iodide of silver, and oxide of amylene, which boils between 95° and 100°. When alcohol or chloroform is employed instead of water in the initial reaction, other products are formed which have not yet been fully examined.

"*On the Action of Reducing Agents on Nitric Acid and Nitrates*," by M. A. Terreio. The author finds that the reduction of nitric acid into ammonia under the influence

of nascent hydrogen, sulphuretted hydrogen, sulphurous acid, and sulphites, takes place with excessive slowness. When, to a mixture of zinc and acidulated water, a trace of nitric acid or a nitrate is added, and when the liquid is decanted, after a few minutes it will be found that the solution possesses the property of decolorising a large quantity of permanganate solution. This shows that very serious errors will be committed in the volumetric estimation of iron with permanganate if all traces of nitric acid are not removed before reduction with zinc. It has been found that chlorates, or chloric acid, do not produce this phenomenon of decoloration; the employment of these oxidising compounds should, therefore, be preferred in the estimation of iron by Margueritte's method. The author proposes to use this decoloration reaction as a test for the presence of nitrates.

CONTEMPORARY SCIENTIFIC PRESS.

[Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the Chemical News.]

Annalen der Chemie und Pharmacie. October.

"*Researches on the Derivatives of Indigo Blue*," by A. Baeyer and C. A. Knop.—"*On the Derivatives of Oleic Acid*," by O. Overbeck.—"*On the Action of Oxychloride of Sulphuric Acid on certain Organic Compounds*," by F. Baumstark.—"*On some Sulphuretted Derivatives of Toluol, and on Toluylene*," by C. Maerker.—"*On a New Series of Organic Diamines*," by H. Schiff.—"*On the Oxidation of Cuminol and Cymol*," by Buliginsky and Erlenmeyer.—"*On Kynurenate of Baryta*," by J. von Liebig.—"*On the Separation of Copper and Palladium*," by F. Wohler.

Annales de Chimie et de Physique. November.

"*Researches on the Tantalum Compounds*" (continuation), by C. Marignac.—"*Fifth Memoir on the Mechanical Theory of Heat*" (third part), by A. and P. Dupre.

Poggendorff's Annalen. October.

"*Optical Researches: 6. On Newton's Rings, and on the Total Reflection of Light by Metals*," by G. Quincke.—"*On the Computation of the Results of T. Kupffer's Experiments on the Elasticity of Heavy Metal Bars*," by K. Zoeppritz.—"*On an Instrument for Measuring the Horizontal Distance and Difference of Level of an Object*," by C. Bohn.—"*On the Estimation of the Heat-conducting Powers of Thin Metal Bars*," by W. Dumas.—"*On Supersaturated Solutions*," by H. Schiff.—"*On the Expansion of Water at Temperatures below 4° Reaumur*," by Weidner.—"*On the Vibrations of a Glass Thread, one end of which is fixed*," by H. Valerius.—"*Note on the Theory of the Spectrum Apparatus*," by L. Ditscheiner.—"*New Meteorites*," by O. Buchner.—"*On the Priority of the Author's Claim with respect to Negative Fluorescence, Calorescence, or Calcescence*," by H. Emmsmann.

Bulletin de la Société d'Encouragement. No. 165. September.

"*Report on MM. Naudet and Hulot's Improved Aneroid Barometer*," by M. le Roux.—"*On the Drainage of London, and on the Utilisation of Sewage in England*" (extract from a report presented to the Prefect of the Seine), by M. Mille.—"*On the Geographical Distribution of Deposits of Native Gold, especially in the Equatorial Regions.*"—"*On the Properties and Applications of Ozokerite*," by J. Fuchs.—"*On the Utilisation of Scrap Tin Plate*," by J. Fuchs.—"*Results of Experiments on the Quantity of Starch contained in Potatoes*," by M. Nobbe.

Fresenius' Zeitschrift für Analytische Chemie. Second Part. 1866.

"*On the Elementary Analysis of Organic Bodies*," by E. H. v. Baumhauer.—"*On the Analysis of Alkaline Silicates with Chloride of Calcium*," by L. R. v. Fellenberg.—"*On a Simple Method of Volumetric Gas Analysis*," by O. Zabel.—"*On the Determination of Loose Earth in Agricultural Soils*," by A. Cossa.—"*On a Pipette for Strong Smelling Liquids*," by E. Jacob.—"*On the Division of Hydrometer Tubes with a Scale of Equal Degrees*," by Dr. Gerlach.—"*On a New Method of Estimating Fluorine*," by R. Fresenius.—"*On the Applicability of Varrentrap and Wills' Nitrogen Process to the Cinchona Bases*," by E. Meusel.—"*On the Chemical Analysis of Inorganic Bodies*," by R. Fresenius.—"*Difference between Antimoniuretted and Arseniuretted Hydrogen*," by H. Dragendorff.—"*On the Limit to some Arsenic Reactions*," by J. Franck.—"*On the Deportment of Copper and Silver to Solutions of Arsenious, Sulphurous, Selenious, and Phosphorous Acids*," by H. Reinsch.—"*On the Estimation of Phosphoric Acid*," by HH. Brassier, Fischer, and Paibram.—"*On the Reaction of Hydrocyanic Acid on Picric Acid*," by A. Vogel.—"*On the Detection of Morphia*," by H. Frohde.—"*Correction of one of the Reactions ascribed to Morphia*," by H. Dragendorff.—"*On the Application of Hydrate of Baryta to Elementary Analysis*," by Kreusler.—"*On the Quantitative Estimation of Strychnine and Brucine*," by H. Dragendorff.—"*On the Estimation of Bismuth in Lead*," by A. Patera.—"*On the Volumetric Determination of Silver for Photographic Purposes*," by A. Vogel.—"*On the Estimation of Uranium in its Ores*," by A. Patera.—"*On the Detection of Nitric Acid in English Sulphuric Acid*," by A. Vogel.—"*On the Estimation of Tannic Acid*," by W. Hallwachs and Th. Koller.—"*Inquiry into the different Kinds of Leather*," by E. Marquis.—"*On the Purification of Sugar for the Polariscope*," by H. Scheibler.—"*On the Volumetric Trial of Colouring Matters*," by H. Pons.—"*On Photometry*," by HH. Leblanc and Bothe.—"*On a Tangent Photometer*," by F. Bothe.—"*On Testing Petroleum*," by HH. Hager, Urbain, and Salleron.—"*On the Estimation of Oily Matter in Vegetable Bodies*," by H. Münch.—"*On the Detection of Cottonseed Oil in Olive Oil*," by R. Reynolds.—"*On the Detection of the Adulteration of Volatile Oils with Alcohol*," by H. Puscher.—"*On the Action of Commercial Benzoic Acid on Cynamic Acid*," by H. Bottcher.—"*On the Action of Chloroform on Alcohol and Alcohol-Ether*," by HH. Otto and Braun.—"*On the Estimation of Amygdalin in Bitter Almonds*," by H. Rieckher.—"*On the various Methods of Estimating Morphia in Opium*," by H. Schacht.—"*Estimation of Santonin*," by H. Rieckher.—"*On the Occurrence of Copper in the Animal Economy*," by HH. Ulex and Losben.—"*On the Behaviour of Blood Corpuscles with Cyanin*," by H. Schönbein.—"*On the Application of a Solution of Bismuth to the Detection of Sugar in Urine*," by HH. Franqui and Van der Vyvere.—"*On the Analysis of Blood*," by H. Zawarykin.—"*On the Application of Chloroform to the Detection of Bile in Urine*," by H. Cunisset.—"*On the Quantitative Estimation of Sugar in Urine*," by H. Bergeron.—"*On the Detection of Strychnine in the Bodies of Animals*," by H. Cloetta.

NOTICES OF PATENTS.

Communicated by Mr. Vaughan, F.C.S., Patent Agent, 54, Chancery Lane, W. C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

2825. J. H. Shorthouse and J. Ferguson, Birmingham, "An improved process for recovering and utilising certain waste metallic products."—Petition recorded October 31, 1866.

2909. G. Shaw, Birmingham, "Improvements in the manufacture of coke, and the small coke called breeze, and in the manufacture of coal gas." A communication

from A. and C. Davies, Liége, Belgium.—November 8, 1866.

2947. G. Crawshay, Gateshead-on-Tyne, and J. Thomas, Newcastle-on-Tyne, "Improvements in the treatment of scoria or slag of copper ores, or scoria from other ores containing iron, in order to extract the iron therefrom, and in refining pig or cast iron to improve the quality of wrought or cast iron."—November 10, 1866.

2957. G. Crawshay, Gateshead-on-Tyne, and J. Thomas, Newcastle-on-Tyne, "Improvements in the treatment of titaniferous iron ores, and in extracting iron therefrom, also for utilising the scoria produced."—November 12, 1866.

3060. E. Morewood, Cheam, Surrey, "Improvements in coating plates or sheets of metal."—November 21, 1866.

3066. P. R. M. Le Guen, Rue Voltaire, Brest, France, "An improved process for combining tungsten with cast-iron by conglomerating reduced wolfram."—November 22, 1866.

3086. J. J. Coleman and T. H. Coleman, Pontblyddyn, Mold, North Wales, "Improvements in the manufacture of hydraulic cements."—November 23, 1866.

3104. W. E. Gedge, Wellington Street, Strand, "Improved apparatus for evaporating the juices of various substances." A communication from J. L. L. Dumont, Faubourg St. Martin, Paris.

3106. W. E. Newton, Chancery Lane, "An improved process for extracting oil and paraffin from bituminous substances, such as peat or coal." A communication from S. L. Wiegand, Philadelphia, Penn, U.S.A.

3112. N. S. Shaler, Cambridge, Mass, U.S.A., "Improvements in preserving animal and vegetable substances."

3114. W. Clark, Chancery Lane, "Improvements in the manufacture or preparation of leather and other materials." A communication from J. F. Pichallu, Boulevart St. Martin.—November 26, 1866.

Invention protected by the Deposit of a Complete Specification.

3131. W. Bidding, Kensington Palace Avenue, Middlesex, "An improved method or methods of treating coffee and tea for general usea."—Petition recorded November 28, 1866.

Notices to Proceed.

1948. W. Weldon, West Hill, Highgate, Middlesex, "Improvements in the manufacture of chlorine."—Petition recorded July 26, 1866.

1950. A. V. Mathieu, Passages des Petites Ecuries, Paris, "An improved apparatus for irrigating the intestines, the vagina, the bladder, the brain, the eyes, and eyelids."—July 27, 1866.

2066. W. Clark, Chancery Lane, "Improvements in the utilisation of chloride of manganese (residue of the manufacture of chlorine) and hydrochloric acid, and in apparatus for the same." A communication from E. A. Cotelle, Boulevart St. Martin, Paris.—August 11, 1866.

2298. J. Schneider, Williamsburg, New York, U. S. A., "A process of making improved beer and ale."—September 7, 1866.

2788. C. McBeath, Blackburn, Linlithgow, N.B., "Improvements in the treatment or distillation of shale, coal, and other bituminous substances, and in the means or apparatus employed therefor."—October 29. 1866.

CORRESPONDENCE.

The Endurance of the Atlantic Cables.

To the Editor of the Chemical News.

Sir,—Your correspondent "T. B." does not coincide in my opinion respecting the necessity of preserving the outer strands of iron wire upon the cables of 1865 and 1866, deeming them of no importance whatever, now that the submarine lines have been successfully laid, and he ignores altogether the question of maintenance and repair. But will it be possible to guarantee the perfection of the insulation for all time to come? If not—and the general experience of submarine cables up to the present day contradicts it*—it would certainly be desirable to have the means of raising them again for the purpose of cutting out a fault and making a new splice; hence it is necessary that the mechanical strength of the cable should remain unimpaired.

My remarks were intended for the future rather than directed to the condemnation of that which has been universally considered a success. I raised the question as to whether the best construction of submarine cable had yet been arrived at, and your correspondent even admits that the use of tarred hemp in 1865 should have been continued in 1866. In the event of another Atlantic cable being manufactured as a reserve for meeting contingencies, this, as well as the other point referred to in my letter of the 19th ult., should receive attention. With regard to the protection afforded by a galvanised coating, I have lately inspected a small piece of the Persian Gulf cable, which, without having been laid in the sea, has all the zinc removed from the inside of the binding wires in consequence of the employment of hemp saturated with salt water as an intermediate wrapping between the cable proper and its outer strands. The soluble chloride of zinc thus formed is a powerful corrosive agent, ready to exert a further influence upon the iron wire in its immediate neighbourhood; and I would venture to submit this also as another instance of a want of foresight in the manufacture of electric cables. I am, &c.

John Spiller.

Chemical Department, Woolwich, December 12.

MISCELLANEOUS.

Meetings for the Week.

Monday, December 24.

Medical Society, 8 p.m.

Thursday, December 27.

Royal Institution, 3 p.m. Professor Frankland "*On the Chemistry of Gases.*" (Juvenile Lectures.)

Friday, December 28.

Quekett Microscopical Club, University College. Paper by Mr. M. C. Cooke on "*Contributions to Microscopical Science during* 1866."

Saturday, December 29.

Royal Institution, 3 p.m. Professor Frankland "*On the Chemistry of Gases.*" (Juvenile Lectures.)

ANSWERS TO CORRESPONDENTS.

Chemical Society.—The observations ascribed to Mr. Tarner in our report of the last meeting were made by Mr. W. H Walenn.

Ilex.—The presence of tannin increases the solubility of iodine in water to a considerable extent.

W. M.—Essence of lemon can be prepared artificially from oil of turpentine by acting on the hydrate of toe oil, first with hydrochloric acid, and then with potassium.

E. B.—Tincture of iodine is a very good application for chilblains before they have broken.

Evans and Jones.—The address of this firm of analytical chemists is 106, Leadenhall-street, E.C.

An Assistant.—Our correspondent has scarcely made out a sufficient case why we should exert our influence with the Government to obtain the repeal of the duty on tobacco for the benefit of chemical assistants.

R. S.—We do not think our correspondents would wish the Chemical News to be enlarged and the price raised. The lectures were promised to us by the authors, and as soon as we receive the manuscripts they shall be printed.

Received—B. J. G.; T. A. P.

Books Received.—"The Management of Steel," by George Ede; "The Pill Book," by Arnold J. Cooley; "On Uncontrollable Drunkenness," by Forbes Winslow, M.D.; Report of the British Association—Nottingham Meeting, August, 1866.

* Vide report of the rupture of the Malta and Alexandria line in to-day's papers.

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(*Concluded from page 297.*)

The last subject we arrive at is volcanic action; and here I do not wish to be misinterpreted. It is not my intention to attack the whole range of the history of volcanoes, and the consideration of their structure and of all the points relating to volcanoes. This would demand a course of a dozen lectures, or more than that. What I purpose to do on the present occasion is simply to direct your attention to one or two, as I conceive, important chemical points bearing on the subject of the chemical geology of volcanoes, and nothing more.

A great deal has been done in this part of our subject, but vastly more remains to be accomplished. Of all the observers who have dealt with it in a chemical point of view, I think, certainly, that no one has been more competent than, or so competent as Bunsen. You will find one of his papers in the Cavendish Society's Reports, 1st vol. Another paper, and a very elaborate one, appeared some time after in the "Scientific Memoirs." Bunsen studied the phenomena in Iceland. I will endeavour to give you, free from all technicalities as far as possible, the essence of those papers.

First, as to the matters which we find in volcanoes. We ought to attend to that point especially—the matters which we find evacuated or expelled from volcanoes. What are they? Well, I have here a list of them as far as I have been able to make one out, and it is a pretty complete one. There may be some deficiencies, but not as far as I know. I will speak of the substances as elements. We have oxygen, silicon, aluminium, iron, calcium, magnesium, sodium, potassium, and I suppose now we shall have to add rubidium and cæsium. Then we have zirconium—(called zircon, as in the lava of Vesuvius)—lithium (in a variety of palagonite), boron (in the state of boracic acid, in the crater of Vulcano, in the Lipari islands, and also evolved with steam in the fumeroles of Tuscany), and chlorine and fluorine. We have also phosphorus in cavities in the lavas of Etna, as phosphate of protoxide of iron; arsenic in combination with sulphur; selenium in association with sulphur from Etna; sulphur in all craters, and in the Solfataras; manganese, titanium, copper, nickel, cobalt, chromium, vanadium, traces of zinc, tin, lead (as galena and chloride), and traces of silver. It is possible there may be a few more bodies, but that is a pretty comprehensive list. No doubt, if further search were made, we should find other matters in small quantities.

Now let us consider the conclusions to which Bunsen arrived. He examined the structure of Iceland especially with a view to trace out the chemical geology of the subject, and I have collected together his most important conclusions.

There are two kinds of igneous rocks which have been ejected, and which compose substantially that island. The one he represents by what he terms the normal pyroxenic rock, containing about 50 per cent. of silica, and the other the normal trachytic rock, which, he says, contains about 80 per cent. of silica. Then, by weathering action upon these rocks, or by the action of certain volcanic exhalations, various products are easily obtained. His theory is that with these rocks, and possibly a third rock rich in chlorine, you may explain the formation of all similar rocks in the whole world; or, to make the proposition still clearer, it is this: take a volcanic rock in any part of the world you please—no matter what it is; analyse it, and you may then represent its composition by an admixture of these two kinds of rocks in certain proportions with each other. He concludes, no doubt properly, that these rocks, at all events in Iceland, have been ejected at different times; and I say he is obliged to assume a third centre of volcanic action vomiting forth another rock rich in chlorine. If this conclusion be true, it is one of great importance. He has given facts to establish this, which I must say, with regard to Iceland, seem indisputable. I need not give you the analyses of these two typical rocks; only remember, the proportions of silica are 50 and 80 per cent respectively. Then he says (and perhaps I had better give you his own words)—"The flow from the two volcanic foci which maintained the activity of the volcano is as irregular as the activity itself." He extends his observations beyond Iceland, and, in proof of the correctness of his theory, adduces the results of analyses of non-metamorphosed volcanic products from various parts of the world. He says that, from a special investigation of the volcanic system forming the high table-land of Armenia, he concludes that the matters composing these rocks have flowed from sources chemically identical with those of Iceland. Chemically identical—that is the point. Nature generally does vary in a very small way. He suggests the idea that all the volcanic formations on the earth's surface have resulted from chemically identical sources. This is a large deduction, and it requires a very large series of observations to establish it. It is hardly established yet, but still the facts, as far as they go, render it highly probable.

Another matter with which we have to deal is the volcanic tuff or tufa. This substance is the result of the agglutination of volcanic ash. In Iceland the celebrated palagonite tuff is stated to be the most ancient of the volcanic series there. Its formation was immediately followed by the elevation of trachyte and clinkstone. Then comes the penetration of the older amygdaloidal trap, which appears in large veins far extending laterally through the tufaceous masses. Next the olivine and basaltic masses penetrated the trap formations in systems of veins of different ages. The series of plutonic elevations, it is stated, closes with the fifth period of the older or more recent lavas.

Palagonite is now recognised as a distinct mineral species. Its mineralogical characters are stated to be as follows:—Its colour varies from amber yellow to colophany brown; it is composed essentially of silicates decomposable by acids, and of others which are not so decomposable. In fact, it may be represented as containing a silicate of the lime series of bases, in the same proportion as the silica and lime exist in wollastonite. It consists of three atoms of silicate of lime, and two of silicate of alumina, the oxygen of the silica being equal to that of the alumina, plus nine of water; that has been found upon analysis, or several analyses. This palagonite rock is derived entirely from metamorphic action, and it is curious and deserving of note that the analyses give iron in the state of peroxide. Now that iron, no doubt, was in the state of protoxide in combination, but during this metamorphic action it has undergone peroxidation. The palagonite tuff consists of a mixture of anhydrous and hydrated silicates. The hydrated silicates which usually cement together the fragmentary rock may be regarded as a mixture or combination of two silicates. The palagonite substance, as Bunsen terms it, appears to occur everywhere as a characteristic constituent of tuff when the pyroxenic rocks are especially well developed. It is met with in the higher basaltic elevations of Germany and France, at Etna, in the Azores, the Cape de Verde Islands, and elsewhere. Bunsen gives analyses of the palagonite, or the cementing matter of the tuff, from various parts of Iceland, from which it appears that the composition is very uniform, the oxygen of the alumina series of bases being about half that of the silica, and the oxygen of the lime series of bases being about half that of the alumina.

Its composition is deduced from a great variety of analyses. Several analyses of the material from various parts of the world lead to the conclusion—this is a general conclusion, of course—that its composition may be precisely represented as a hydrated pyroxenic rock, or that, given the hydrated pyroxenic rock to which I adverted a short time ago, and succeed in combining that with water, you get this palagonite. Now, this is a beautiful conclusion, and one, I think, well established, as to the combined effect of metamorphic action, volcanic action, and water. Bunsen arrived at the conclusion that a palagonite substance may result from the action of lime on pyroxenic rock at a high temperature, and he cites the observation of Darwin on basaltic lava which had run over a recent deposit of limestone. Then he says the product of this mutual action is described as a breccia-like conglomerate in which the altered lava is mixed with a very pure mass of carbonate of lime. The mixture, he says, had the appearance of having been kneaded in a pasty state, which, according to Bunsen, excludes the possibility of supposing that fragments of the limestone accompanying the lava had originated from subsequent infiltration. "The chemical change," he says, "which has resulted from the contact of limestone with the lava, does not leave any doubt as to the nature of the process by which the palagonite has been formed. Wherever the lava is in contact with the limestone, it is converted into a mass presenting all the mineralogical characters and chemical reactions of palagonite; and this metamorphism, characterised by a gradual transition into the unaltered rock, is more fully developed where the calcareous substance preponderates over the constituents of the mass." Then he goes on and presents us with numerous theoretical considerations about this matter, which I do not think are altogether satisfactory. It is a generalisation which is deserving more and more of the attention of geologists, either for its confutation or confirmation. It relates to the common origin of all the rocks composing the crust of the earth, or the possibility of referring them to two typical rocks. We must assume the agglomeration of the normal trachytic and the normal pyroxenic, and there must be a third. For reasons which I cannot now enter into, this subject has not received the attention of geologists to the extent it deserves. It is an essentially chemical matter.

Now as to the gases evolved from volcanoes. Let us look at these for a moment or two. There is a very large amount of gaseous emanations or exhalations of some kind or other. There is no doubt about that; and a very large proportion of this matter is certainly steam or the vapour of water. It is very difficult indeed, if not impossible, to collect gases from the active volcano for examination, and we can get facts concerning them only inferentially by collecting the gases from small cracks or fissures called fumeroles.

We know that liquid water has been thrown out in torrents from volcanoes, and dead fish are said to have been ejected also, showing the access of sea-water into the interior.

One of the gases ejected is free hydrogen, which appears as a constituent in many analyses. A very large proportion was found by Bunsen in the gas from the smoking muddy soil of a large fumerole in the far north of Iceland. That would argue the presence of some matter in water far down in the deep earth. That matter would appear to be protoxide of iron which becomes peroxide. Then carburetted hydrogen or marsh gas occurs. Bunsen sought for it very carefully, but he could not find it in the gases of Iceland. Deville, however, tells us that he found marsh gas in the gas evolved from the liquid lava of Vesuvius thrown out in 1861, and also a very large proportion in the gas of fumeroles near Etna—as much as 90 per cent. in this instance. Carbonic acid is a general constituent of volcanic gases. Then comes hydrochloric acid, which is very commonly found, and which may have a very important action in developing various secondary products—as clay, for example, from obsidian and the like. Then there is sulphurous acid, which may also act in a very powerful way upon many rocks with which it may come in contact. Sulphuretted hydrogen also occurs. Sometimes we get this and sulphurous acid both together, which in contact decompose each other with the separation of sulphur, and this may be one way in which sulphur occurs in volcanoes. Sulphurous acid is sometimes found to the extent of 15 per cent. Sulphuretted hydrogen appears to play an important part in the transition of certain rocks. I will give you Bunsen's words:—"As the resulting products have an acid reaction, owing to the oxidation of the sulphuretted hydrogen and the formation of sulphuric acid, they can contain neither carbonate of lime nor silica, and accordingly these bodies are never found in them. The acid would, of course, dissolve out the carbonate of lime, and as there is no acid there to decompose the silicates formed there would be no separation of silica." That is obvious enough. Then sulphuric acid proceeds from the oxidation of the sulphuretted hydrogen, which therefore rapidly decreases, while the carbonic acid does not. Bunsen gives us facts to prove that. Thus we get, you see, sulphuric acid easily as a separate product from the oxidation of the sulphuretted hydrogen, and with the sulphuric acid we can of course effect great changes. Thus we can easily account for the formation of sulphate of lime under certain conditions, and there is no doubt that in some cases it has been so formed. There has been some difficulty in accounting for it or for the presence of sulphuric acid.

You must not suppose that I bring this forward as an exhaustion of the whole subject. We have only trenched on the subject. We shall require many years to understand right well the chemistry of volcanoes. There are many points exceedingly difficult of solution, and requiring great attention.

Sulphur is a substance occurring continually in our volcanoes—in fact, volcanic sulphur used to be our chief supply for the manufacture of sulphuric acid. There is always a sublimation of sulphur in volcanoes. Now, if we admit the presence of masses of that substance down below, and heat sufficient to sublime it, of course there is no difficulty in understanding how we meet with it; but I am afraid we cannot resort to that assumption. Then Bunsen suggests that there are sulphides from which sulphur could easily be eliminated by heat alone; but, as far as I know, there is only one sulphide, that of iron, which can be supposed to exist in a sufficiently large quantity to give forth this sulphur. About half its weight of sulphur would be given off by heat. But then, again, we require proof of the presence of that bisulphide down below, and, as far as I know at present, no proof has been given.

Perhaps one of the most interesting parts of the paper by Bunsen, with regard to volcanic action, is this—namely, the influence of gases penetrating through a rock along with aqueous vapour, and changing the constitution of that rock without the addition of anything to it or the subtraction of anything from it—a gaseous metamorphism, so to speak, of these rocks. I should say that this pneumatolytic action on rocks is one of the most important matters to geologists. He says that even the zeolitic amygdaloid which occurs abundantly in Iceland is only a variety of trap metamorphosed on the spot without the removal or deposition of any matter whatever. In support of this he advances the fact that one passes by insensible gradations into the other, and that the average composition of the amygdaloidal rock, abstracting the water, is identical with that of the trap. Then he gives us several experiments; and I have given you several statements which prove indisputably that all zeolites may be so produced under the action of water, especially at a high temperature.

We find nitrogen as a constituent of volcanic gases, and it is probable that that nitrogen comes from atmospheric air. We may assume that to be correct, but I must here refer to a conjecture put forth by Deville and Wöhler with regard to the formation of ammonia. They suppose that at one time a nitride of silicon largely composed the crust of the earth. This nitride, remaining for a long time in contact with the vapour of water, would generate silica on the one hand, and ammonia on the other. We have no proof whatever of the existence of such a compound as nitride of silicon in the bowels of the earth, though we can make it in the laboratory without difficulty; but, still, this is one of those theoretical considerations which it is well to bear in mind. With regard to ammonia as a volcanic exhalation, it is found in combination with hydrochloric acid. It may often be found in the form of sal-ammoniac, which may be found in almost every geological cabinet. Bunsen tells us that, some months after the eruption of 1846, he observed the lower part of the lava stream studded over with smoking fumeroles, in which, he says, so large a quantity of beautifully crystallised muriate of ammonia was undergoing a process of sublimation, that, notwithstanding the incessant torrents of rain, hundreds of pounds' worth of this valuable salt might have been collected. Its production was limited to the zone in which meadow land had been overflowed with lava, and higher up the muriate of ammonia and the last traces of vegetation ceased together. Hence he concludes that the ammonia is derived entirely from the organic matter of the soil. Then Liebig, on the other hand, believes that the ammonia has not organic origin. However, that is a point about which we know very little for certain, and it must be left for still further investigation.

There is still a question whether flame is ever really seen in volcanic eruptions. I know that, in newspaper reports of eruptions, flame is stated to be seen, but there may not be flame notwithstanding. What is supposed to be so may be merely the vapour of water illuminated by incandescent matter below, and it is not very easy to distinguish between the two. Still, if hydrogen be evolved, which there is no ground for disputing, there is no reason, considering the high temperature, why flame should not be produced.

Well, these are the chief points to which I would direct your attention. The great question of all is, how we can account for the great heat manifested by volcanoes. At one time the theory was put forth, by Davy especially, that metallic bases existed very deep down in an unoxidised state, and that these bases, coming in contact with water, decompose it, and we get, in consequence, a large quantity of the alkaline earths produced; and this theory would of necessity involve the elimination at the same time of a corresponding amount of hydrogen gas. The amount must have been enormous; that is certain. Now we do not get any proof of this hydrogen gas, as far as I know, to account for the production of these alkaline bases on this wholesale scale, and that theory has been abandoned. Then comes the question—What is the cause of the heat? How are we to account for the generation of that enormous amount of heat? It is not, I believe, a very intense heat. I think there is often a mistake on that point. We are apt to imagine that when there is a very large mass of matter molten, that implies of necessity a very intense heat; but I do not think it does. We can melt lava or any kind of volcanic matter you like without a very intense heat. We do not want intense heat; we want the long-continued action of heat. The question is whether the heat we find here developed is the result of long-continued chemical action. Have we any facts on the subject? Well, I think at present there is nothing satisfactory known about it. How can we explain this production of heat by chemical phenomena? What phenomena are there in volcanoes to justify the belief that the heat does arise from chemical changes? Is there any sulphur, for instance, burnt by the access of oxygen? Well, as far as I know, there is not; and at present I think we must, as far as facts furnish us with any information on the subject, keep in abeyance the theory of the production of heat in volcanoes by chemical action. It may be due to the continued refrigeration of our globe, and the contraction of the exterior upon the still molten interior. It may be that that theory is the correct one.

In concluding this series of lectures, I beg to thank you for your attention. I regret that I have been obliged to hurry over this great subject. It is impossible to present you with anything very satisfactory in the first or second series of lectures on such a subject as this. If I have the pleasure of meeting you again, I hope to be able to present you with something more worthy of your attention.

CONTEMPORARY SCIENTIFIC PRESS.

[Under this heading it is intended to give the titles of all the chemical papers which are published in the principal scientific periodicals of the Continent. Articles which are merely reprints or abstracts of papers already noticed will be omitted. Abstracts of the more important papers here announced will appear in future numbers of the Chemical News.]

Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften zu Wien (Mathematical and Natural History Section). Vol. 53, div. 1.

No. 5. May.

"*On the Preparation of Hæmin from Blood, and on Detecting the Presence of small Quantities of Blood*," by J. Gwosdew.—"*On the Action of Chlorine on Amylene*," by A. Bauer.

Monatsbericht der königlich-Preussischen Akademie der Wissenschaften. June.

"*On the Decomposition of Bisulphide of Carbon by Chloride of Iodine, and on the Products obtained thereby*," by R. Weber.—"*On the Spectrum of the Electric Brush and Glow Discharge in Air*," by A. Schimkow.—"*Supplement to a Memoir on the Electricity of the Muscles*," by Du Bois-Reymond.—"*A Method of taking Continuous Observations of the Temperature of the Sea during Sounding Operations*," by W. Siemens.

Annalen der Chemie und Pharmacie. November.

"*On Rhœadin, an Alkaloid obtained from Papaver Rhœas*," by O. Hesse.—"*On the Action of Bromine on Propionic Acid*," by H. L. Buff.—"*On the Transformation of Peroxide of Propylene into Acetone;*" "*On a Convenient Method of Preparing Diallyl*," by E. Linnemann.—"*Analysis of the 'Raw Steel Iron'* (Rohstahleisen) *produced at Biber, Hesse-Cassel*," by A. Baoh.—"*On the Quantitative Estimation of the Colouring Matter of Blood by Means of the Spectroscope*," by W. Preyer.—"*On Hyposulphite of Platinum and Sodium* (Platinür-Natrium-Hyposulphit)," by P. Schottlander.—"*On Hydrated Protoxide of Copper*," by C. Weltzien.—"*On Diethylglycoll and some of its Compounds;*" "*Contributions to the Knowledge of Thiodiglycollic Acid*," by W. Heintz.—"*On a Compound of Phosphate of Potash and Soda, analogous to the Double Salt of Ammonia and Magnesia*," by MM. Schröcker and Violet.—"*On Sulphide and Disulphide of Benzylene*," by M. Fleischer.—"*On Ethylidene*," by B. Tollens.—"*On the Presence of Indium in Wolfram*," by F. Hoppe-Seyler.—"*On the Assumed Presence of Salt in Extract of Meat from South America*," by J. von Liebig.—"*Contributions to the Knowledge of Osmium*," by F. Wöhler.

Dingler's Polytechnisches Journal. October.

"*On the Radiation of Heat from the Walls of Furnaces*," by C. Schinz.—"*On the Bessemer Process with Reference to the Methods of Producing Steel hitherto in use, and to the Puddling Process*," by Krieger.—"*On the Behaviour of Silicium during the Puddling Process*," by List.—"*On C. Lesimple's Explosive Compound*," by H. Vohl.—"*A*

New Process for Ascertaining the Quantity of Tanning Matters in Bark," by F. Schulze.—"*On an Optical Saccharometer suitable for Testing very Dilute Solutions of Sugar*," by C. Stammer.—"*Zymotechnical Miscellanies. 8. On the Composition of the Deposit formed in Tubes used for Conveying Wort*," by J. C. Lermer.—"*Analysis of the Crude Boracic Acid of Tuscany*," by H. Vohl.—"*On a Specimen of Bauxite from Feistritz*," by H. Wedding.—"*Analysis of the Pottery Manufactured at the Royal Works at Charlottenburg*," by Kolbe.—"*On the Preparation of Pure Acetic Acid and Acetates from Pyroligneous Acid by means of Baryta*," by C. R. Richter.—"*Lucifer Matches without Phosphorus*," by C. Liebig.

Revue Universelle des Mines. July-August.

"*Experiments on Heating Water by Means of Steam*," by P. Havrez.—"*On the Extraction of Nickel in Nassau*," by Schnabel.—"*On the Production of Graphite in Austria*."—"*Aluminium Solder*," by Mourey.—"*Analysis of Lead and Copper Ores made in the Laboratory of the School of Arts, Manufactures, and Mines at Liége*," by J. Kupferschlager.

Annales des Mines. No. 2.

"*Memoir on the Deposits of Iron Ore on the South-west Coast of Norway*," by T. Kjerulf and T. Dahll.—"*Memoir on the Regulation of Chronometers and Watches in Vertical and Inclined Positions*," by Phillips.

CORRESPONDENCE.

Organic Matter in Water.

To the Editor of the Chemical News.

Sir,—Under the head of "Composition and Quality of the Metropolitan Waters in November, 1866," in your last number, a statement is made by Dr. Letheby of very great importance to chemists, and especially to water-analysts.

The words to which I refer are the following:—"It (the organic matter in the waters) is entirely of a vegetable nature."

A process that would enable us to fix the "composition and quality" of the organic matter in water in this indubitable way has long been wished for; and Dr. Letheby will not, I trust, hesitate to make known the means by which he has arrived at the above most interesting result.

I am, &c.

B. J. G.

London, December 18, 1866.

MISCELLANEOUS.

Chemical Society.—The limited space at our disposal this week compels us to defer a full report of the proceedings transacted at the meeting of the 20th inst. We simply announce the election of Messrs. John Broughton, Watson Smith, and W. N. Hartley, as Fellows of the Society, and enumerate the papers read. These were—"On the Basicity of Tartaric Acid," by Mr. W. H. Perkin, F.R.S.; "On the Absorption of Vapours by Charcoal," by Mr. John Hunter, M.A.; "On Some Reactions of Hydriodic Acid," by Mr. E. T. Chapman. Mr. MacLeod exhibited and described an ingenious "Continuous Aspirator." The meeting was adjourned until 17th January.

Royal Polytechnic Institution.—The Christmas entertainments at the Polytechnic include a new optical illusion, the "Decapitated Head" (or rather the Trunkless Head) which was briefly noticed in our columns on the 7th inst. To this has just now been added, at the suggestion of Professor Wheatstone, an exhibition of his new discovery, the Eidoscope, which consists of a series of pleasing effects produced upon a screen by the slow motion of variously perforated plates, which, by overlapping, allow of the passage of light only in symmetrical figures, and these are sometimes coloured for the purpose of heightening the general effect. The Cherubs in the Air have given way to an elegant modification, in which the Shakspearian characters of Ariel and Lance make their appearance in mid-air, in obedience to the summons of the immortal bard, who is admirably impersonated by Mr. F. Damer Cape. A mechanical life-sized figure of great merit, called the Automatic Leotard, performs several athletic feats on a trapeze suspended in the Great Hall; whether actuated by clockwork, or by electric or magnetic agency, is a problem which will tax the ingenuity even of the scientific to solve. This patented invention is the joint effort of Messrs. J. H. Pepper and S. F. Pichler. Mr. George Buckland gives a new musical entertainment founded on the story of Whittington and his Cat, the leading incidents of which are shown in the way of dissolving views and ghostly apparitions, resources which seem both destined to outlive the existence even of the Institution itself. We can only briefly allude to an admirable rendering of Mr. Charles Dickens's Christmas Carol, which likewise gives an opportunity for the display of some clever ghostly illusions. The whole programme seems appropriate to this festive season, and provides for the entertainment of the public whilst administering in some degree to their instruction.

Meetings for the Week.

Tuesday, January 1, 1867.

Royal Institution, 3 p.m. Professor Frankland "*On the Chemistry of Gases.*" (Juvenile Lectures.)

Pathological Society (anniversary), 8 p.m.

Wednesday, January 2.

Pharmaceutical Society, 8 p.m.

Obstetrical Society (anniversary), 8 p.m.

Thursday, January 3.

Royal Institution, 3 p.m. Professor Frankland "*On the Chemistry of Gases.*" (Juvenile Lectures.)

Saturday, January 5.

Royal Institution, 3 p.m. Professor Frankland "*On the Chemistry of Gases.*" (Juvenile Lectures.)

ANSWERS TO CORRESPONDENTS.

IMPORTANT NOTICE.

With the next volume of the Chemical News *will be immediately commenced an illustrated series of papers on the Application of the Blowpipe to Quantitative Analysis and Assaying, by David Forbes, F.R.S. Also, a full account of Professor Stas's recent Memoir on Atomic Weights, with a detailed description of the processes employed. An entirely new and complete set of Tables for Qualitative Analysis, by Dr. Hofmann, F.R.S., and some articles on Cyanogen, by Dr. Odling, F.R.S., are also in preparation, and will appear as soon as ready.*

*** In publishing letters from our Correspondents we do not thereby adopt the views of the writers. Our intention to give both sides of a question will frequently oblige us to publish opinions with which we do not agree.

*** All *Editorial Communications* are to be addressed to the Editor, and *Advertisements* and *Business Communications* to the Publisher, at the Office, 1, Wine Office Court, Fleet Street, London, E.C. *Private* letters for the Editor must be so marked.

Vol. XIII. of the Chemical News, containing a copious Index, is now ready, price 11s. 6d., by post, 11s. 6d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our Office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our Office, or, if accompanied by a cloth case, for 1s. Vols. I., II., and VII. are out of print. All the others are kept in stock. Vol. XIV. commenced on July 6, and will be complete in 26 numbers.

J. C., C S2, J. Noble, J. Simpson, Smatterer, F. Y., Anxious Inquirer, Q. Q. Q., Mathematicus, and other correspondents, are informed that, owing to the unusual length of the Index, we are compelled to defer answering their queries, &c., till next week.

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